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Compressed Air Magazine

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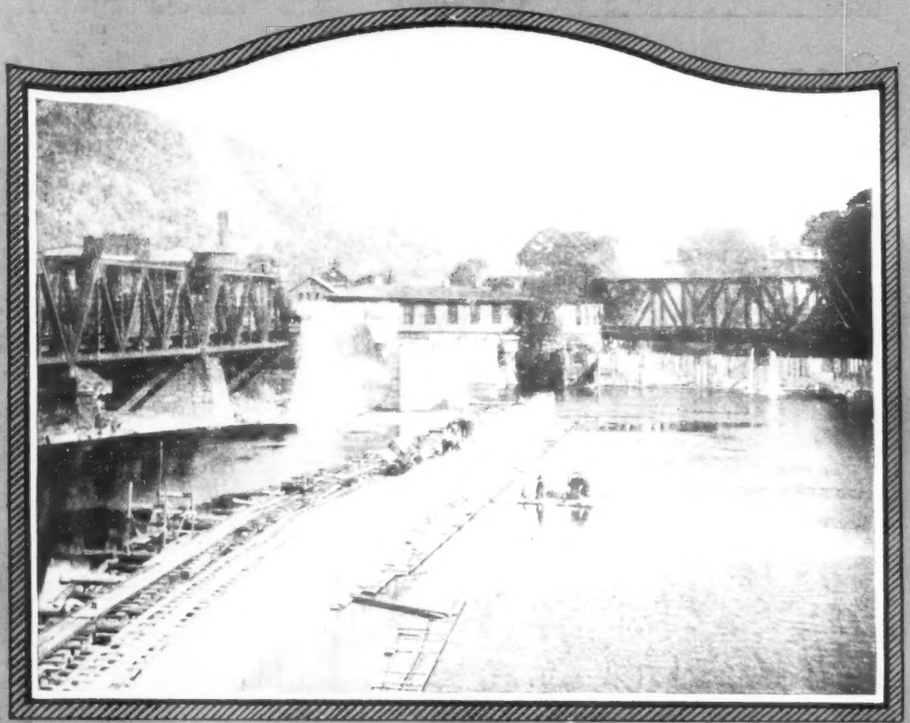


COFFERDAM AT SITE OF NEW DAM ON CONNECTICUT RIVER FOR A LARGE HYDRO-ELECTRIC PLANT AT BELLOWS FALLS, VERMONT

Compressed Air Does Record Work in Utah Silver-Lead District
Gail Martin

Some Diesel-Engined Tugboats in Use on the Pacific Coast
C. A. Berst

Sixty Thousand Horsepower From the Connecticut River
R. G. Skerrett

When Ships Took Natural Ice to Distant Warm Countries
C. H. Vivian

(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 26)

Waukesha-Equipped Universal Crane for Snow Loading

n-774-LC

Saving Public Funds

The portable heavy-duty gasoline engine is the greatest man power and money saver known to the Industrial World. At Syracuse, N. Y., is the Waukesha-engined crane shown above. There, during one 50-hour blizzard, 36 inches of snow fell. Eight and nine-foot windrows, made by the plows, had to be cleared away in record time. Loading 9 to 10 yards every two or three minutes, this crane easily took the place of from 50 to 75 shovelers.

Cleaning up snow is an emergency job. Any delay means thousands of dollars loss to the public through the failure of their transportation systems. Waukesha engines are of the heavy-duty type, designed to do just such tough jobs. Contractors who have to meet penalties must not gamble with engines of questioned reliability. That is why you find them buying equipment powered by Waukesha "Ricardo Head" engines in preference to other makes. Let us send you "Industrial Units," a book showing some of the 32 different industries in which Waukesha power is used.

N-803-LC

INDUSTRIAL EQUIPMENT DIVISION

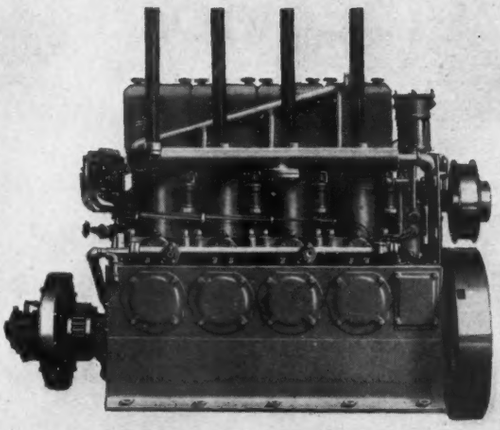
WAUKESHA MOTOR COMPANY

Waukesha **Wisconsin**

New York	Kansas City	Denver	Tulsa	Houston	San Francisco
8 W. 40th Street	*V. L. Phillips Co.*	*Wilson Machy. Co.*	*C. F. Camp Co.*	*Portable Rotary Rig Co.*	*C. A. Watts*

Exclusive Builders of Heavy Duty Gasoline Engines for Over Twenty Years

A PRACTICAL Diesel Excavator!



P&H FULL DIESEL
4-CYLINDER MOTOR
NON-VIBRATING

BURNS LOW GRADE FUEL — COLD START

AFTER 4 years of development work, and testing out many types of Diesel Engines made both here and abroad, P & H now offers a practical Diesel Excavator—one that will start and run as dependably as a gasoline motor. It's a Full Diesel machine [not semi-Diesel] and burns low grade fuel-oil costing from 5 to 8 cents a gallon.

Because of the weight and power of Diesel Engines, absolute rigidity is essential and P&H Excavators were designed with this in mind. The massive UNIT CAST STEEL FRAMES hold the engine and machinery in perfect alignment at all times, assuring many years of low cost service.

Just dictate a note for complete information.

The P&H Exhibit
is WW29
1928 Road Show
CLEVELAND
January 9—13

Model 700 Diesel
1¼ Yd. Capacity
Weight 88,000 lbs.

Model 600 Diesel
1 Yd. Capacity
Weight 69,000 lbs.

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Established in 1884
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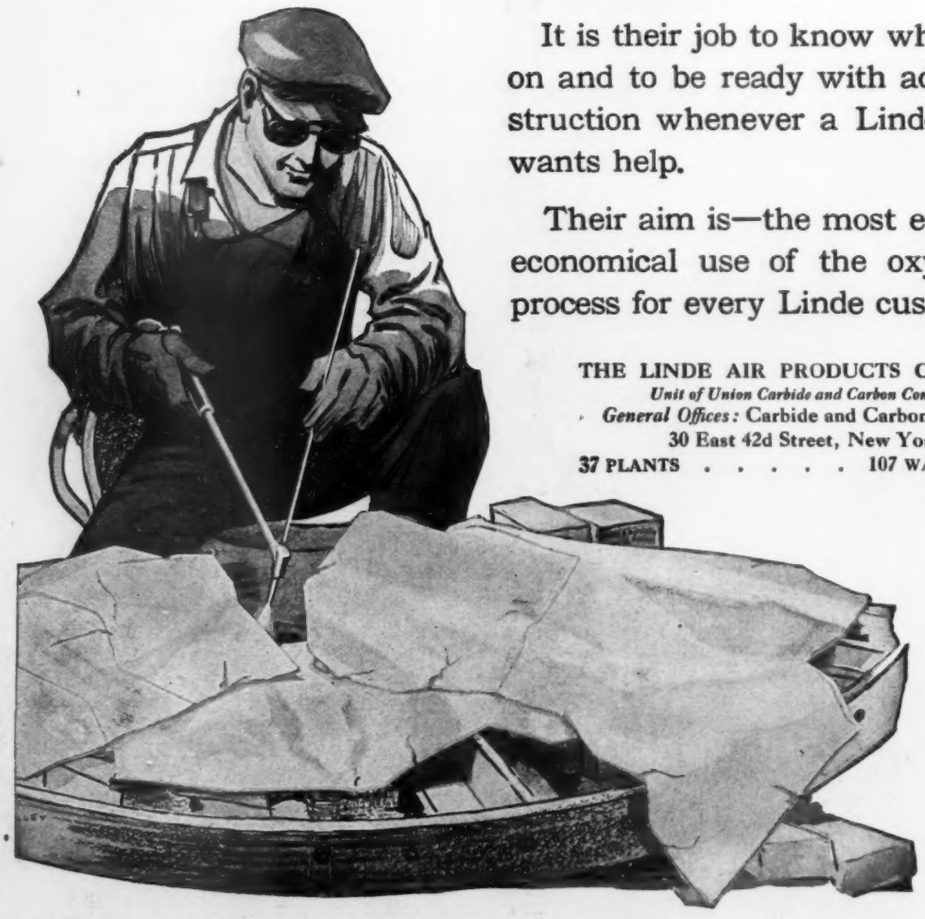
The WHY of Linde Welding Service

IN A FIELD that is developing and has developed as rapidly as that of oxy-acetylene welding and cutting, it is impossible for even the most alert welder or engineer to keep abreast of new developments.

That is one of the reasons for Linde's service staff.

It is their job to know what is going on and to be ready with advice or instruction whenever a Linde customer wants help.

Their aim is—the most efficient and economical use of the oxy-acetylene process for every Linde customer.



THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Company
General Offices: Carbide and Carbon Building
30 East 42d Street, New York
37 PLANTS . . . . . 107 WAREHOUSES

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UTILITY

A useful product is not just a happening but the result of years of patient, careful effort. Prest-O-Lite dissolved acetylene has been on the market for twenty-three years, with an ever-increasing volume of sales. That is proof of utility.

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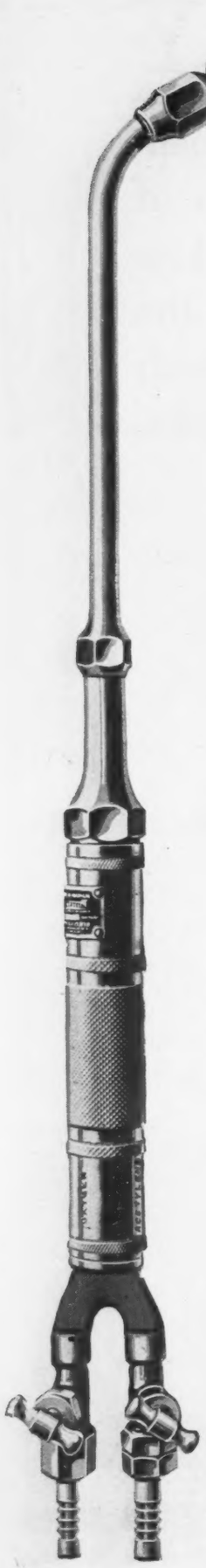
General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York

31 Plants—102 Warehouses

Prest-O-Lite

DISSOLVED ACETYLENE



Prest-O-Weld pays for itself

How soon will this piece of equipment pay for itself?

Whether you use Prest-O-Weld for repair or construction work you need only five good jobs, that you formerly could not do or had to have done outside, to make this equipment pay for itself.

It is therefore not so much a question of whether you can afford a Prest-O-Weld kit as whether you can afford to be without one.

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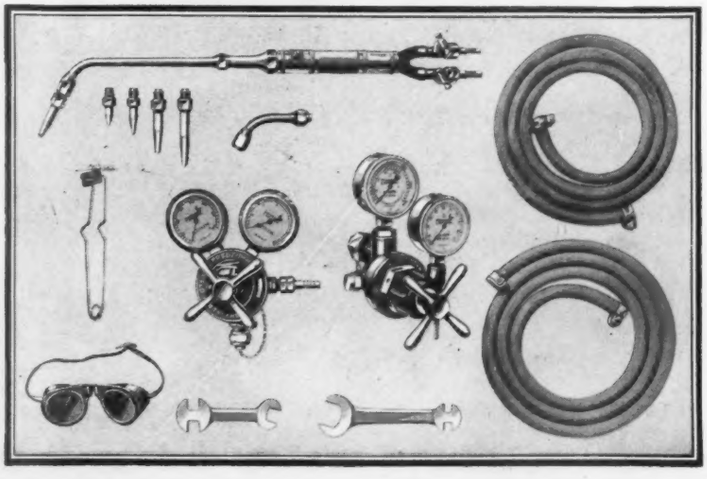

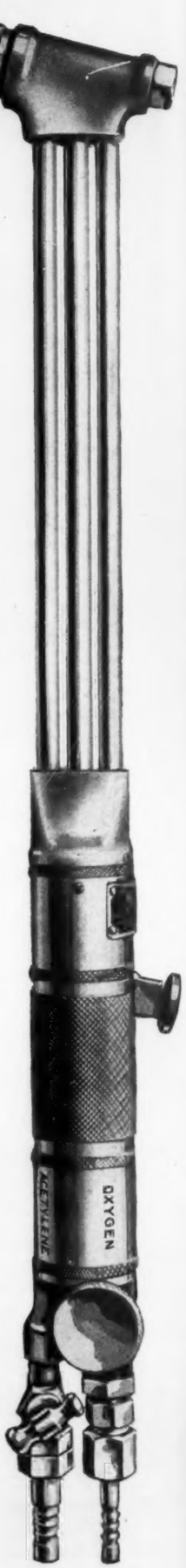

THE HOSE THAT LASTS LONGER

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An efficient, tight, and trouble-free line is a money-maker and a money-saver in all compressor duty.

Goodyear Air Hose is made with an understanding of these values. It is built to carry full loads without leakage, and to perform this dependable service over a long, economical life.

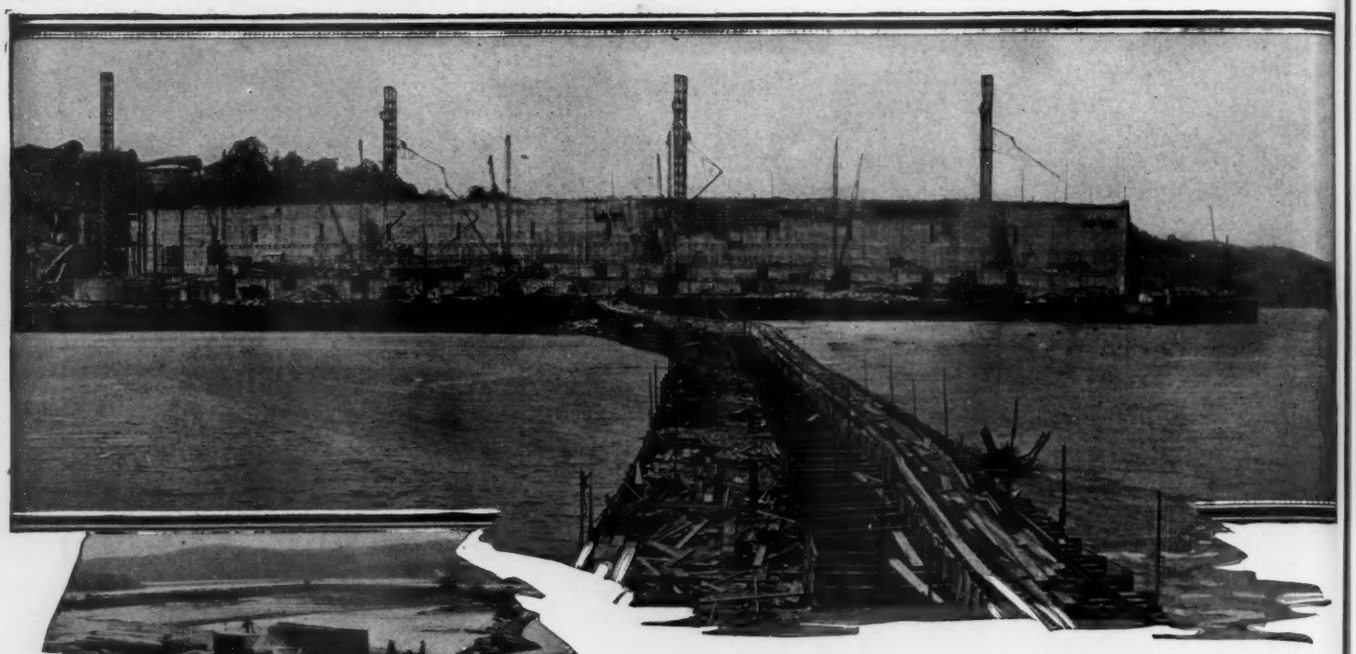
The tube of this efficient hose is specially compounded to resist oils. The body is made of stout plies of rubber—impregnated canvas, resilient to the pulsating pressures, and quick to return to full round when pinched or flattened. A good, thick, tough cover protects against abrasion in hard usage.

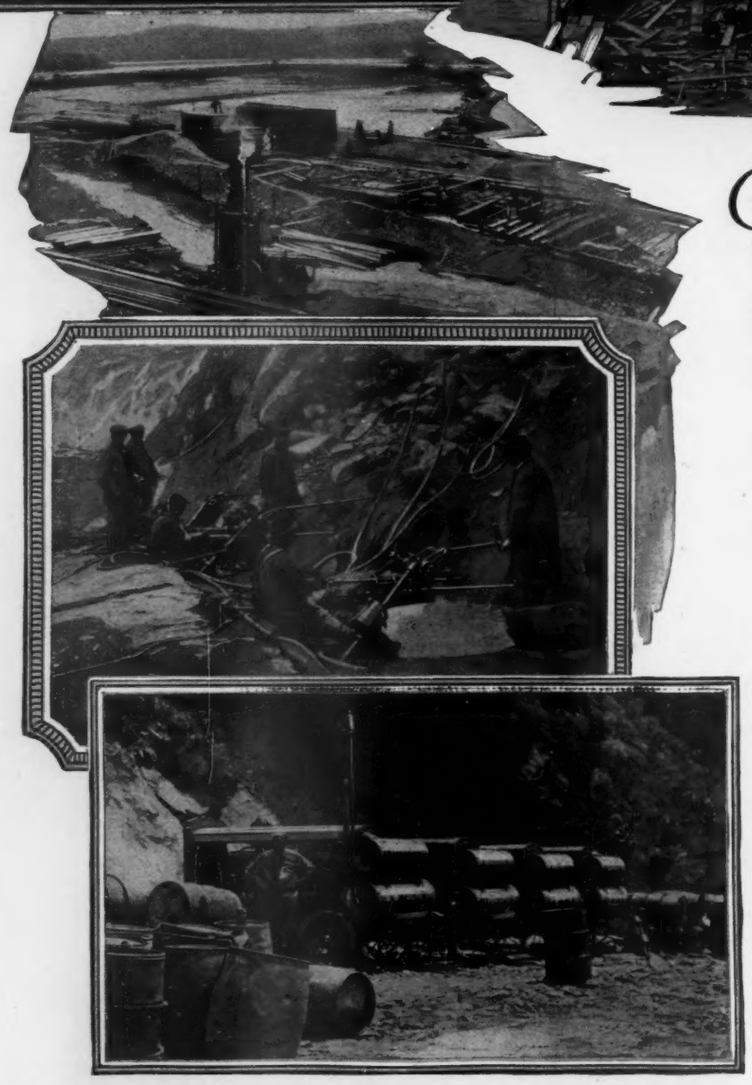
Goodyear Air Hose resists the effect of kinking to the maximum degree.

For detailed information about this and other types of Goodyear Hose, write to Goodyear, Akron, Ohio, or Los Angeles, California.

The Greatest Name in Rubber

GOODYEAR





More History

THE RAPID PROGRESS being made on the Conowingo dam and hydro-electric project marks another chapter in the history of the "World's Important Projects" and another milestone in the accomplishments of The Philadelphia Electric Company.

The work of harnessing the Susquehanna River has attracted unusual interest and is being watched by engineers in all parts of the world.

The undertaking is unique in size, method of procedure, and speed of completion. The dam, with a total length of 4,800 feet will be 300 feet longer than the great dam at Muscle Shoals; moreover, it is being built against a strong current and varying water levels. The plant will be in operation in 1928.

The dam and powerhouse as a whole was designed and is being constructed by Stone & Webster, Inc., under the direction of Wm. C. L. Eglin, Vice-President and Chief Engineer of

There is an Ingersoll-Rand Branch near you. At this Branch you can obtain expert engineering assistance, competent mechanical service, and prompt deliveries of complete machines and spare parts.

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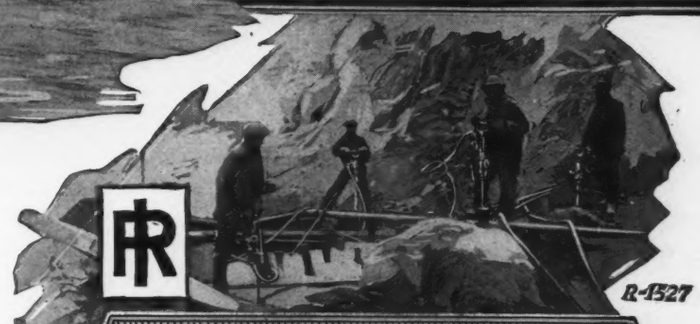

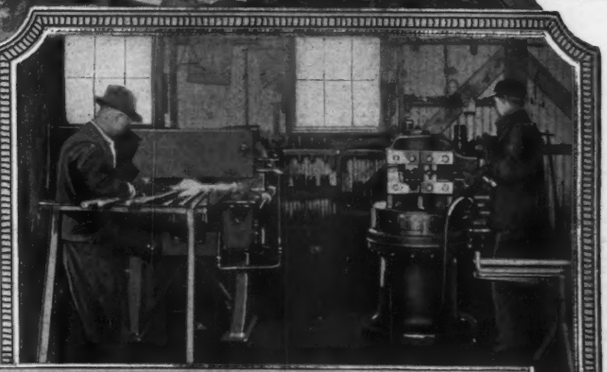

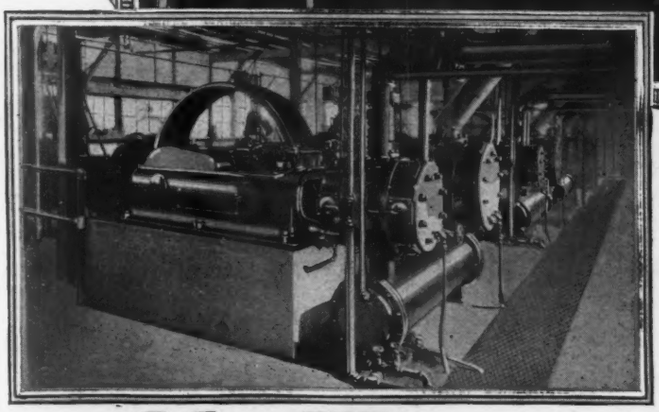

in the Making

The Philadelphia Electric Company. The abutment on the east bank and the spillway are being built by the Arundel Corporation of Baltimore.

The relocation of 16 miles of railroad (Columbia and Port Deposit Branch of the Pennsylvania line) is also being done by the Arundel Corporation.

As on almost every large project of importance, Ingersoll-Rand machines are an important factor in the work. I-R Compressors are supplying air on both sides of the river; tripod-mounted X-71 drills are drilling the deep holes in the excavation for the power house; DCR-23 "Jackhamers" and I-R Paving Breakers are used for breaking up boulders and cleaning the river bottom before the concrete is poured. "Leyner" Sharpeners assure a plentiful supply of sharp, perfectly made steels. Portable air compressors are used on the job wherever extra air is needed.

INGERSOLL-RAND COMPANY
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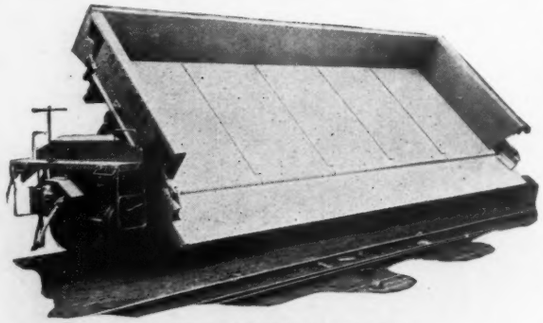
52 RDM

Ingersoll-Rand

At the Orwell Pit on the Mesaba Iron Range, a Marion Model 300 Stripping Shovel is loading Western Dual Side Pivot Drop Door Dump Cars. These are low-loading 25-yard cars, taking four 8-yard dipper loads per car.

On the Job Every Day

That is the kind of performance you can expect of the new Drop Door Western. Further, you can expect cost reducing performance of the new Drop Door Western. Its simple, single stroke air cylinders use less air. It dumps fast and clean. In stripping it will dump more loads in one spot without spreading, due to its ability to dump in a "plugged" dump. It has an unobstructed opening for dumping. These features, combined with the great strength of this new "Western" car, give lower operating costs and lower maintenance costs of cars and tracks. These cars have given satisfaction wherever used.



Western Drop Door Dump Car

Bulletin 27-QAM gives complete details. A word from you will bring full information.

Western

WESTERN WHEELED SCRAPER COMPANY

Pioneer Builders of Dump Cars

AURORA, ILLINOIS, U. S. A.

BLASTING COSTS LOWERED

by the HERCOMITES Number 2 to Number 7.

(Originally announced as the new Hercules Extras No. 2 to No. 7)

ONE of the greatest values we have ever offered is this new series of powders similar to the Hercules Specials.

Economy in explosives costs is an outstanding feature of the new Hercomites No. 2 to No. 7. A cartridge of the new Hercomite is equal in strength to a cartridge of the corresponding Extra L. F. or Gelatin grades shown in the table. Hercomites are bulky, that is they contain more cartridges to the 100 pounds than other explosives. Therefore, they give you more explosive value for your money.

HERCOMITE No. 2 is nearest grade to	50%-60% Extra L. F. or 40% Gelatins
HERCOMITE No. 3 is nearest grade to	40%-50% Extra L. F. or 35% to 40% Gelatins
HERCOMITE No. 4 is nearest grade to	35%-40% Extra L. F. or 25% to 30% Gelatins
HERCOMITE No. 5 is nearest grade to	30% Extra L. F.
HERCOMITE No. 6 is nearest grade to	25% Extra L. F.
HERCOMITE No. 7 is nearest grade to	20% Extra L. F.

Where applicable these powders save from ten to thirty percent. A variety of cartridge strengths are available ranging from 50% for Hercomite No. 2 to 20% for Hercomite No. 7.

The quality of the fumes produced by the new Hercomites makes them especially adapted for underground work.

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Sales Offices:—Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.

Hercules Powder Company, Inc.
932 King Street, Wilmington, Delaware

Please send me additional information regarding the new Hercomites, No. 2 to No. 7.

Name _____

Company _____

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1515

Industry's demand...
is Ever Forward

To think ahead and realize that the purchase today must continue in efficient service and keep apace with the growth of the demands of the customer for a future period is a fundamental principle of International Combustion Engineering Corporation.

An illustration of this is the era of the industrial stoker. The Type E stoker, developed by a subsidiary of International Combustion, is an outstanding example of how the industrial stoker problem was met. In this stoker, there was developed a machine meeting a specified condition; the economical and efficient burning of bituminous coals in industrial practice.

Then came the development of the Coxe stoker, designed to change a drug on the market into an asset through its ability to burn efficiently and automatically the small fine sizes of anthracite coal, and culm. Coxe stokers not only gave to the manufacturer in those districts where such fuels were available a cheap and efficient fuel, but also performed a service to the mine operator in creating an outlet for what had heretofore been road filler and swamp reclaimer.

Following these two divergent examples of the thinking ahead policy of International Combustion came the further developments of multiple retort stokers for central station work and the outstanding developments made in traveling grate stokers of tremendous capacities, making doubly efficient bituminous coals throughout the world for station use.

Other developments followed—*ever forward.*

It was an International Combustion subsidiary that was first to see and develop the possibilities of pulverized fuel as a power plant fuel.

Then came air heaters, recovering the heat ordinarily passed up the stack and returning it to useful work inside the furnace. Associated with this development came the fin tube furnace, which

removed the last limitation in high furnace temperatures by eliminating brick work and bringing the furnace wall into combination with the boiler, changing the side walls from a yearly loss to a yearly profit for the power plant. Water screens at the bottom of the furnaces, in conjunction with these fin screens, completed this radical new thought in power plant design.

It was at this point that engineers throughout the world realized that furnace construction had far surpassed the capacity of the ordinary boiler and again International Combustion stepped forward with the new steam generator in which the brick furnace walls, as built in an old boiler installation, making no steam, became boiler heating surface now producing in this new unit more than 50% of the total steam produced.

And finally, as a direct result of years of research and a definite forecast of the demands of the future, International Combustion is presenting the only commercial methods in operation today for distilling coal at low temperatures, which means untold ultimate economies in the development of power throughout the world through the recovery of the by-products, illuminating gas, oils, tars and motor spirits which are known to be in bituminous coal, and last but not least the production of a smokeless fuel.

It is generally acknowledged that the burning of coal in its raw state with all its valuable products is economically wrong.

This is what we mean when we say that industry's demand is ever forward; seeking and receptive to new economies and efficiencies. To keep faith with industry in making such power plant practice available is the task to which the affiliated companies responsible to the parent International Combustion organization have set their shoulders.

George E. Learnard
President.

International Combustion Engineering Corporation
International Combustion Building
New York City

10" rising main laid in record time.

400 yards of 2½" pipe laid in an hour.

Fast Work Saved Flooding Mine

Four hundred yards of 2½ in. pipe were laid in an hour, at night by men who had never seen a Victaulic Coupling. Not a joint leaked. Also this 10 in. line including 360 ft. of rising main installed in a vertical shaft, was assembled and in service in 12 hours—fast work which prevented serious losses from mine flooding. A 10 in. flanged-joint line of the same length, placed in the same shaft, at the same time, required 96 hours to install.

Advantages of All-purpose Victaulic Couplings

For speed and ease of installation, Victaulic Couplings are unmatched.

A Victaulic Coupling can be completely installed by unskilled labor in two minutes. The only tool needed is a wrench.

The Victaulic Coupling cannot be put together wrongly. The housing automatically centers the sealing ring and the bolts cannot be drawn up unless the housing shoulders correctly engage the shoulders of the pipe and grooves—enabling perfect joints to be made under water or in the dark.

Victaulic Couplings permit a considerable deflection of the line at each coupling. Pipes do not have to be in perfect alignment during installation.

With Victaulic Couplings on a line, no special swing joints or expansion bends are required because Victaulic Couplings take care of the contraction and expansion of the abutting pipe lengths due to temperature variations.

Victaulic Couplings provide permanently leak-proof joints which are not affected by vibration, subsidence of the ground or sudden changes of pressure or temperature.

Maintenance costs are greatly reduced because any defective pipe lengths can be removed and replaced without disturbing any other length.

Victaulic Couplings have passed the most rigorous service tests and are used by leading oil, mining, gas and water companies in all parts of the world.

Victaulic Couplings are available for all sizes of steel, wrought iron and cast iron pipes from ¾ in. up—for all pressures from vacuum to ten tons pressure per square inch.

For detailed information and list of uses and users, write for Victaulic Bulletin No. 5

The all-purpose couplings

VICTAULIC COMPANY OF AMERICA

26 Broadway New York

FLEXIBLE LEAK-PROOF

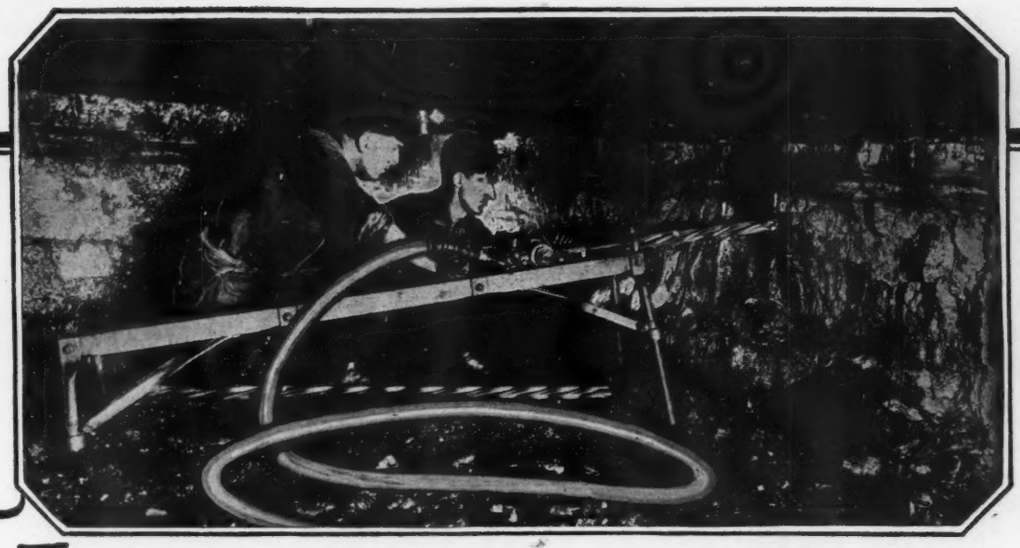
VICTAULIC

REG. U.S. PAT. OFF.

PIPE COUPLINGS

FOR OIL, GAS, WATER, SEWAGE, COMPRESSED AIR, ETC.

"For every joint on the line"



Hose- that gives you "AIR MILEAGE"

"TYPE 50"

Multiple braided reinforcement of hard twisted cords.
All parts united by High Pressure, perfect adhesion.
Tough Red Cover
Mineral Oil-Resisting tube.

An ideal hose for pneumatic tools—tough and strong, yet light, flexible and easily handled. Also for air drills where a light-weight hose is preferred.

"COMMANDER"

De luxe air drill hose. Cover of toughest known compound of rubber, out-wearing several times its own thickness of steel. No armoring necessary. Also for severest service on pneumatic tools.

Air hose, like a tire, can hold pressure only so long as the tube is intact. And, like the tread of a tire, the cover of air hose must endure all sorts of abuse—pinching under heavy weights; chafing against rock or metal; cutting against sharp corners.

Goodrich air hose has an inner tube of special oil-resisting rubber, compounded to resist the action of the most malignant mineral oils—it keeps its strength 200% to 500% longer than ordinary rubber.

The cover of Goodrich Air Hose is tough, brawny rubber, 50% stronger than ordinary air hose cover—it will outwear any kind of steel armoring.

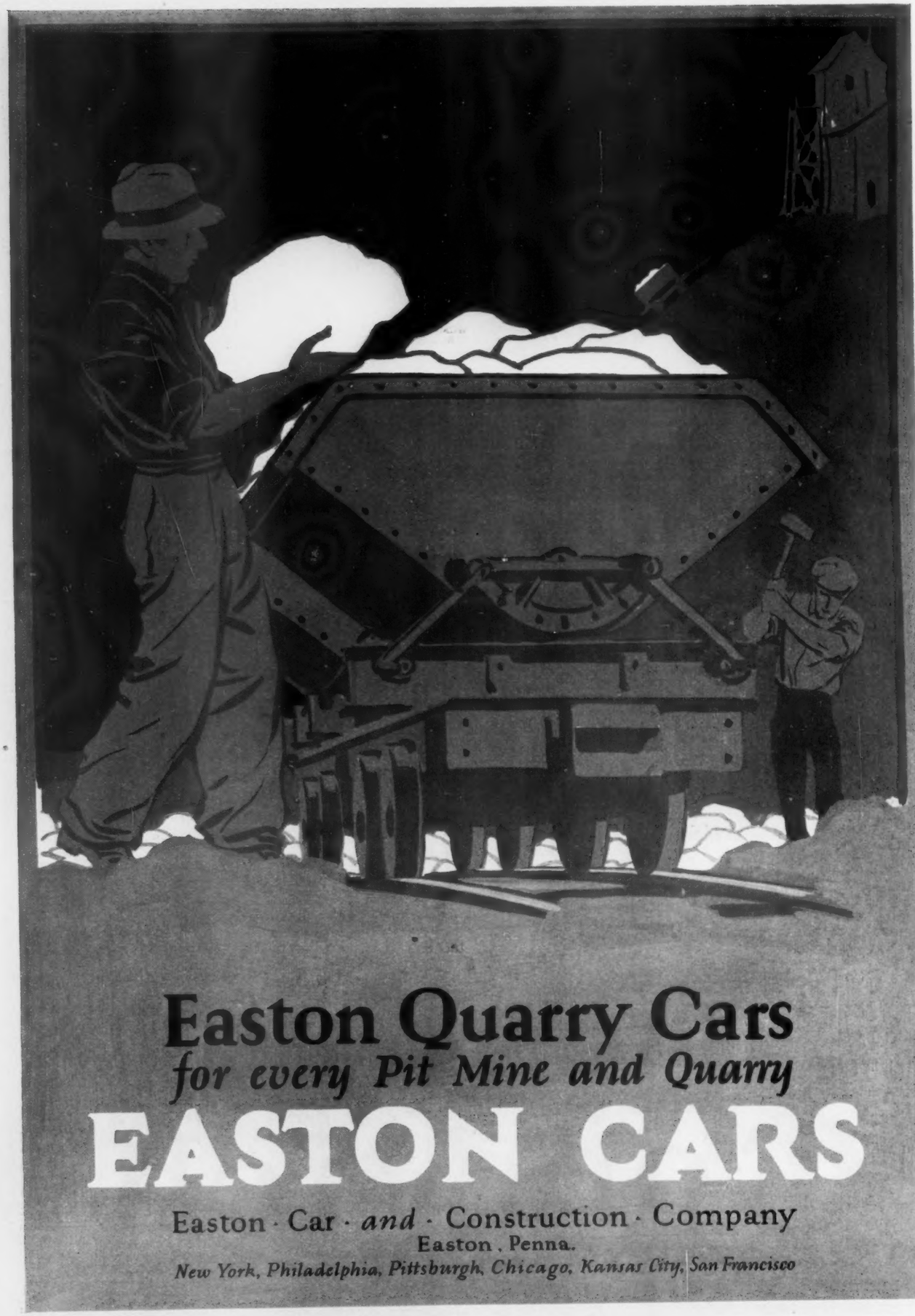
Goodrich Air Hose is built to give you extra *"air-mileage"*—just as Goodrich Silvertown Tires give you extra *road-mileage.*

The B. F. GOODRICH RUBBER COMPANY
Established 1870 Akron, Ohio

Goodrich

"TYPE 50" AIR HOSE "COMMANDER"

Listen in every Thursday Evening, 10 to 11 Eastern Standard Time, 9 to 10 Central Standard Time over the WEAF Red Line Hook-up



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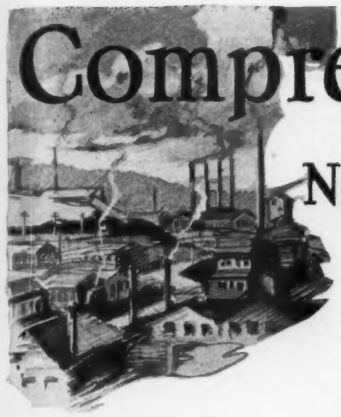

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Principal Offices
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No. 11 Broadway
New York.

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Compressed Air Magazine Co.
FEBRUARY, 1928

Sixty Thousand Horsepower From the Connecticut River

Fine Plant at Bellows Falls, Vt., Nearly Completed For New England Power System

By R. G. SKERRETT

MORE power is to be drawn from the Connecticut River to generate a large block of electric energy. This current will be fed into a far-flung system that already serves many communities in New England. Here, again, we have a striking example of the repeated utilization of the descending flow of a stream that has great potentialities as a source of power but that, heretofore, has been made use of to only a relatively moderate extent. We have, in this instance, another example of the beneficial activities of the New England Power System.

New England's water wheels, in decades gone, were largely responsible for the growth of many of the industries in which that section of the country became a leader. It was by utilizing its falling waters to generate power that New England, for a goodly while, was able to offset her lack of coal deposits. Subsequently, the New England mills expanded, and they found that needed additional power could be produced more satisfactorily by steam plants. They gradually placed proportionately less and less dependence upon their time-honored water wheels even though they had to pay rather heavily for fuel originating outside of New England.

But this increasing reliance upon imported fuel imposed inevitably an industrial penalty; and certain of New England's mills have been conspicuous sufferers. The record upbuilding of hydro-electric plants in the South, and the rapid expansion of electrically driven textile mills in that climatically favored part of the country, have made serious inroads upon the supremacy previously enjoyed by textile mills in New England.

It is a matter of common knowledge how New England producers have been affected by this migration of industrial activity; but it is not generally known that other long-established manufacturing enterprises in that region have suffered in a similar manner and in varying degrees. That is the price many managements have paid for their reluctance to abandon their steam plants and to adopt, instead, a different form of motive energy generated by New England's numerous rivers and streams. This reluctance has, in part, been due to a broad recognition of the inefficiency of most of the water wheels used for decades in New England and elsewhere under conditions that permitted little if any control of seasonal changes in stream flow. So much for the past. Now, let us consider the economic and the industrial revolution that is being effected in the New England States through skillful hydraulic engineering.

This profound change for the better, which is altering the whole aspect of power production in that section of the country, is the outcome of the rearing of a succession of dams, for example, on rivers that often have only an average stream flow of moderate volume—the dams serving to conserve the abundance of freshet periods so that the impounded water can be drawn upon for fairly uniform utilization over the entire twelvemonth. Furthermore, the same water is in this way made to do useful work repeatedly as it flows seaward.

In this field of service, which combines the utilization as well as the conservation of natural forces, the New England Power System has been conspicuously prominent for some years; and *Compressed Air Magazine* has already called attention to one or more outstanding examples of that company's enterprise. The present article describes the latest project of the New England Power System. This un-

HYDRAULIC engineers are solving the problem of supplying New England with much of its needed power from sources within its own domain. The economic significance of this becomes clear when it is recalled that a great many of New England's outstanding industries have long been dependent upon fuel obtained from other states.

The New England Power System has been the foremost agency, in latter years, in creating hydro-electric plants capable of distributing large blocks of energy throughout the New England States; and the present article has to do with the latest of these undertakings—that just put in service at Bellows Falls on the Connecticut River.

The work at Bellows Falls is especially interesting because the scene of operations was recently exposed to flood waters of unusual height and violence. Thanks to the foresight of the engineers, not one of the permanent structures was seriously damaged during the inundation. This is a record of which all concerned may be proud.

Left—Canal conveying water to the powerhouse, showing manner in which sloping banks have been paved to prevent erosive action. Right—Part of forebay just below stone highway bridge, now removed.

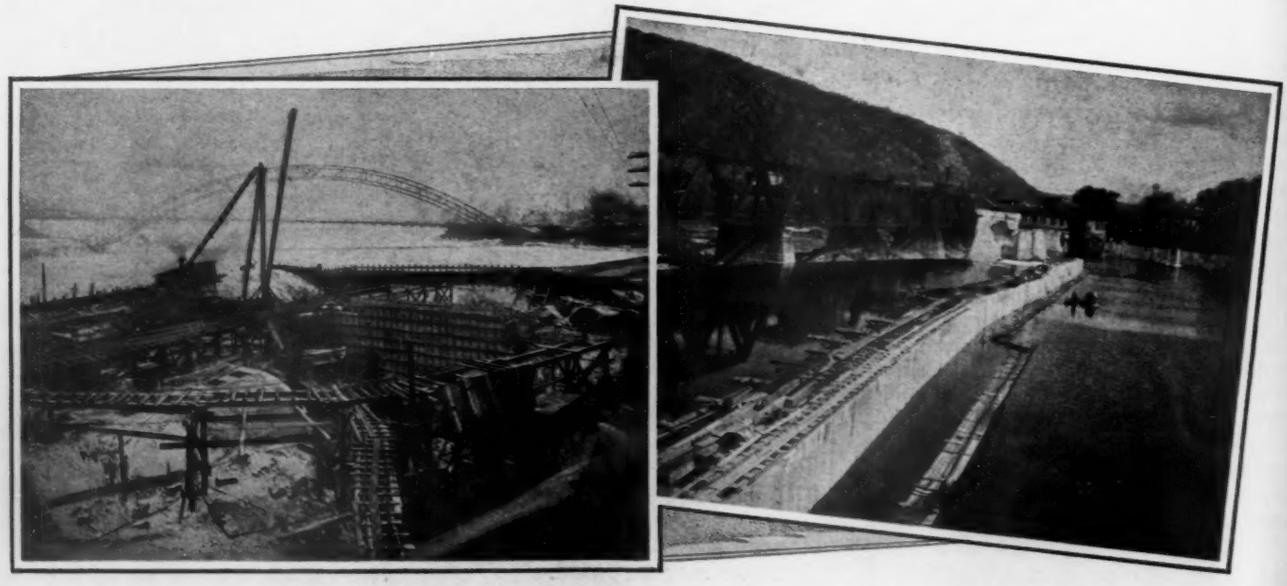
dertaking will make it possible to generate in a single plant a block of energy totaling 60,000 hp. A better conception of what this represents can be had if it be borne in mind that previously, at the same location on the Connecticut River, substantially 75 water wheels in various local mills were able to produce an aggregate of only 10,000 hp.

Bellows Falls, in the southeastern part of Vermont, is situated on the Connecticut River at a point where that stream makes a decided drop because of a rocky barrier interposed there ages ago by Nature; and about that favorable site there have grown up mills or manufacturing plants of one sort or another that make use of the descending waters to drive water wheels for power purposes. In this way, Bellows Falls, as a community, gradually attained the dignity of a sizable town, and prospered. Today, Bellows Falls is not as bustling as it once was; but what the New England Power System is doing there will, in all likelihood, speed up the industrial life of the place. Before describing the activities of the New England Power System, it might be well to sketch briefly how Bellows Falls acquired, in the first place, its industrial importance through its location on the Connecticut River.

Something like a century and a quarter ago—along about 1800, a dam was erected there and a canal dug and equipped with locks as a means of promoting navigation that far up on the Connecticut. There is no evidence that that effort to stimulate water transportation was especially successful; and gradually, as time passed, more and more use was made of the canal as a source of power for turning relatively crude water wheels. Bellows Falls has represented a more or less typical water-power development of the period of 75 years ago; and the original canal was subsequently augmented or superseded by a system of canals which produced hydraulic heads varying from 20 to 25 feet at the wheels.

When Bellows Falls was at the crest of its activities, the Connecticut River at that point actuated something like 75 water wheels in the various mills—generating, as has already been said, an aggregate of about 10,000 hp. The total head developed under that old arrangement was substantially 45 feet; and there was a great waste of water both because of the inefficient character of the wheels installed and of the rather restricted employment of the water available. The redevelopment of this admirable power site insures an effective head of about 60 feet; and this head will be utilized to drive three single-runner wheels, each capable of producing 20,000 hp. That is to say, these wheels will utilize 10,000 second-feet, whereas the old installations that they supplant used only 2,500 second-feet of water. As might be supposed, the modernizing of a water-power system dating back three-quarters of a century represented a somewhat exacting problem, because existing water users had to be taken care of while making improvements designed to bring the whole system up to date.

As has been widely common in the past, the original dams at Bellows Falls were of timber-crib construction, and were placed along the head of the falls—extending from point to point of the ledge. In 1907, a concrete dam was built of the same height as the previous timber-crib dam to replace the older structure; and this concrete dam was reared downstream and close to the crib dam. Paralleling, as it



Left—Winter work on the new dam at Bellows Falls.
Right—Cofferdam across the Connecticut River at the site of the Bellows Falls dam.

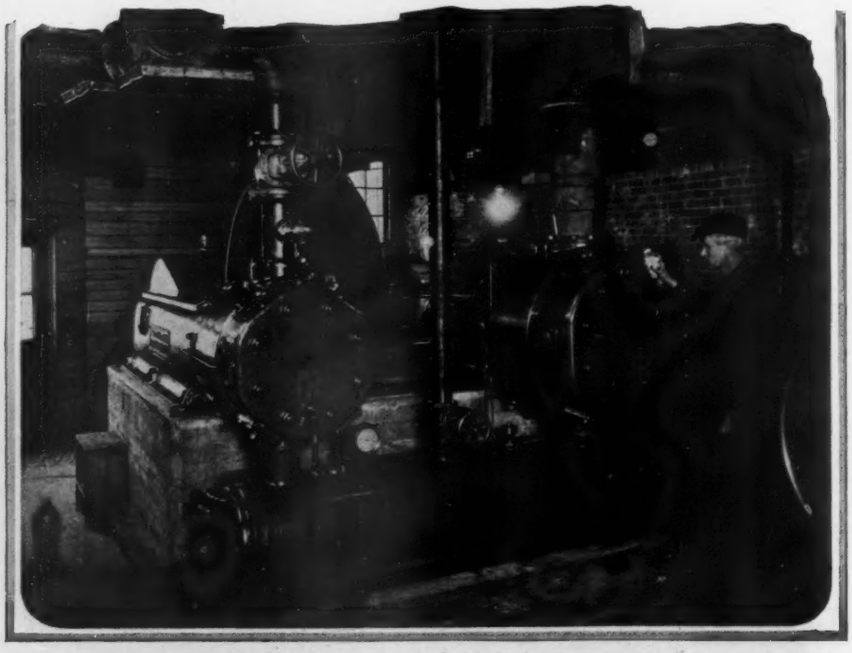
1—Excavations for draft-tube tunnels as seen from the tailrace during one stage of the work.
2—"Jackhamers" clearing away rock in the tailrace with the portal of Draft-tube Tunnel No. 2, at the extreme right, and men making ready to start work on Draft-tube Tunnel No. 3.
3—Diversion wall and excavation for the tailrace with draft-tube tunnels visible behind the steam shovel.
4—Ingersoll-Rand X-71 drills in position for starting work on Draft-tube Tunnel No. 3.
5—General view of the power site with the cofferdam in position to facilitate excavating the tailrace.
6—Tailrace excavation and diversion wall, looking downstream from the tailrace.

Blacksmith shop, equipped with a No. 25 oil furnace, a "Leyner" sharpener, and an I-R pedestal grinder to keep drill steels in condition for the work expected of them.

did, the crib dam—which zigzagged across the river—the newer dam, because of its irregular form, had a very inefficient spillway. This was the situation when the New England Power System essayed its present undertaking.

The redevelopment project involved the construction of a new dam that crosses the Connecticut River in a straight line. As a result of the removal of the ledge and the greater impounding capacity of the new dam, there has been brought about an improvement in the waterway below the dam. For this purpose the dam has been equipped with two large roller gates, which have their fixed crest 5 feet below the crest of the old dam. In making these changes, the hydraulic experts of the New England Power System have increased the available head at the power plant by raising the elevation of the water in the pond above the dam and by placing the turbines at a lower level. At the same time, the capacity of the canal was amplified. It was, incidentally, necessary to improve flood conditions occurring during high water or the prevalence of ice floes.

These desired ends have been realized by raising the operating level 11 feet above that possible with the old dam. This new operating level is controlled by means of the two aforementioned roller gates—each of which is 115 feet long and 18 feet high—and by flashboards in three other panels of the dam. These flashboards are 13 feet high and placed in three bays, two of which are 121 feet long and the third 100 feet long. The flashboards are controlled from a 5-span steel bridge above the crest of the dam. The gates are handled by hoists located on top of the piers, as well as by remote-control means in the powerhouse. The flashboards are arranged so that they can be moved as small units by a traveling crane, or all the flashboards and their supports along the length of the crest can be cleared by tripping facilities which are controlled from the bridge. This can be done within a period of only a few minutes.



One of the two Ingersoll-Rand XCB compressors that provided operating air for various purposes during the construction of the new hydro-electric plant at Bellows Falls.

In the construction of the cofferdam in the river, required in unwatering sections of the site of the new dam, wooden sheet piling was used. The piles, 3x6 inches in cross section, were driven to resistance with CC-35 air-operated paving breakers equipped with new frontheads for service of that kind.

The canal, by which water is carried a distance of about a third of a mile from the dam to the forebay, was dug in earth or, to be more explicit, the canal is merely the old waterway enlarged. Because of the very limited space within which the necessary improvement work could be done, the modernizing of this canal proved something of an engineering problem. Its location placed certain definite limits upon the power plant, which receives its motive water by this channel. That is to say, had it been possible to still further enlarge the original canal, then the capacity of the power plant could have been augmented proportionately.

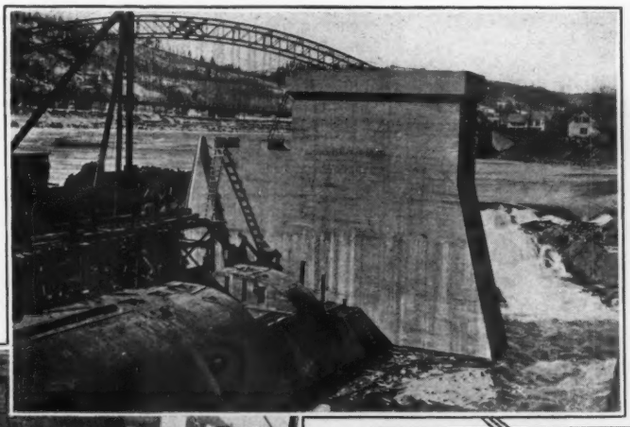
The sides of the canal have a slope of 1 in 1¼, which is admittedly very steep for an excavation in earth. To offset this, rather novel means were employed to insure the stability of the sides of the canal. The slopes were steadied by a series of concrete ribs, spaced at uniform intervals and extending from the bottom of the canal upward until they join a continuous parapet wall along the top line of the operating water level. The sections between these ribs, as well as the bottom of the canal, were paved with rock having a minimum thickness of 18 inches. The concrete ribs and the rock paving make it entirely practicable to operate the canal safely when the water is flowing through it at a velocity as high as 6 feet per second.

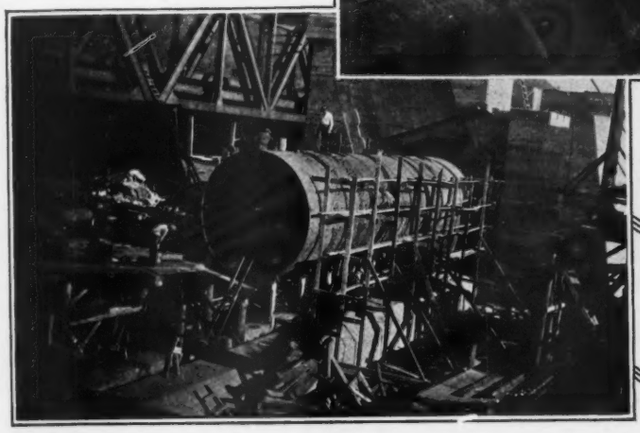
The forebay, the powerhouse, and the tailrace necessitated the excavating of a large amount of rock. This, however, worked out economically, because it reduced greatly the quantity of concrete required. In the forebay, which extends for about 200 feet upstream from the powerhouse, there was excavated approximately 25,000 cubic yards of solid rock in order to increase the size of that basin and thus to reduce the velocity of the water as it approaches the racks in front of the wheel entrances. In the powerhouse area, including the three draft-tube tunnels, the rock removed totaled 30,000 cubic yards. In the tailrace, extending from the outlet of the draft tubes to slack water below the powerhouse, there was excavated from the intervening ledge a total of 50,000 cubic yards of rock. In addition to this, a matter of substantially 25,000 cubic yards of combined earth and rock was removed. These figures give some idea of the task involved in rearranging and remodeling this old power site. It may be of interest to recall that the new powerhouse occupies the spot

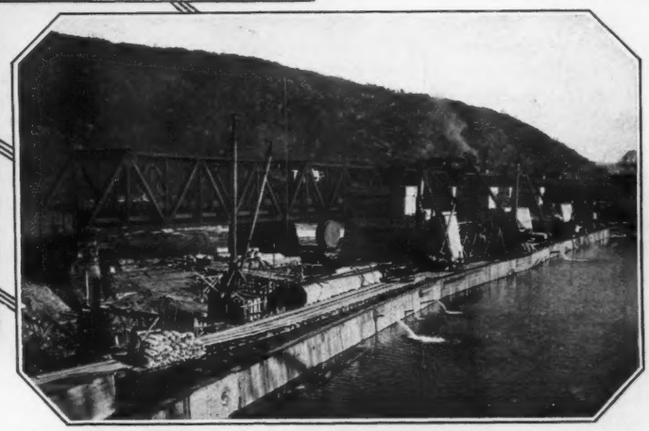
on which previously stood a mill of the International Paper Company.

The rock excavated for the foregoing purposes was of a granitic nature and seamy, making the drill runner's job a rather hard one. In clearing away this rock, the deep holes were generally driven with X-71 drills mounted on tripods; but in driving the headings for the draft-tube tunnels the X-71 drills were mounted on columns with arms, permitting a number of holes to be drilled without shifting the column. For drilling shallower holes, DCR-23 "Jackhamers" were utilized extensively. To keep the steels continually fit for service, the blacksmith shop of the Sherman Power Construction Company—which actually did the work—was provided with a No. 50 "Leyner" sharpener, a No. 25 Ingersoll-Rand oil furnace, and an Ingersoll-Rand air-driven pedestal grinder.

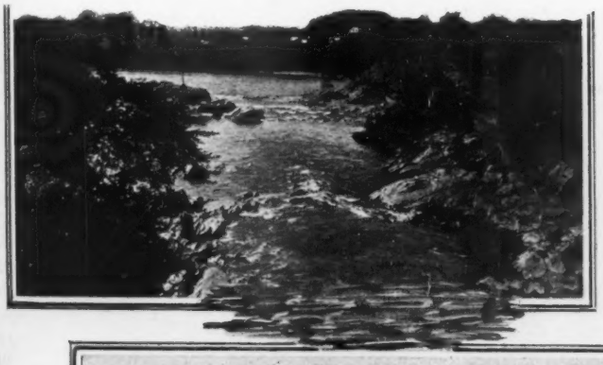
Compressed air was used on the job for drilling, for operating a number of pumps, and to actuate the blacksmith-shop equipment just

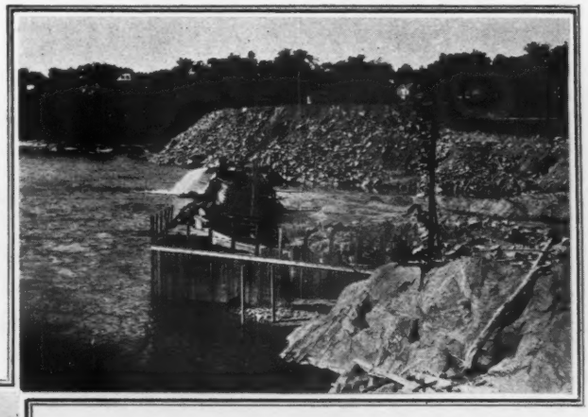


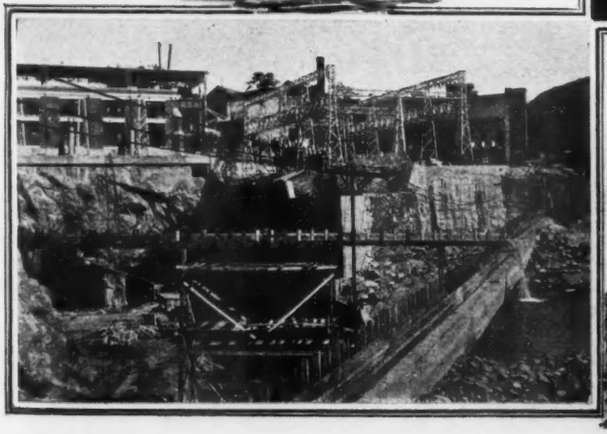




Top—As the dam appeared in the spring of 1927.
Left—Close-up of one of the large roller gates partly assembled. Each gate is 18 feet in diameter and 115 feet long.
Right—This photograph was taken early in October of last year when the dam was completed with the exception of Pier No. 4 and the abutment and the spillway crest near the New Hampshire side of the Connecticut River.







Top, left—Looking downstream from above the power site, at the right. Right—Cofferdam built to unwater the river bed for excavating the tailrace.
Bottom, left—Powerhouse, one of the switch yards, and the diversion dam on the downstream side of the plant. Right—Looking upstream from a point below the powerhouse site.

mentioned. The air was supplied by two XCB compressors, having cylinders of 20 and 12½ inches in diameter, with a common stroke of 16 inches. Each of these machines was driven by a 200-hp. General Electric synchronous motor—one aftercooler serving both compressors. During the period of construction, the air pressure on the line was maintained at 100 pounds at the aftercooler. The air was distributed to the various points of use through 6-inch lines.

The water wheels in the powerhouse and the roller gates at the dam were furnished by the S. Morgan Smith Company; the caterpillar headgates were built by the Philips & Davies Company; and the electrical equipment was supplied by the General Electric Company. The engineering work, in connection with this undertaking, was done by the New England Power Construction Company which, like the Sherman Power Construction Company, is a subsidiary of the New England Power Association.

Work on the project was started on April 15, 1926; and, according to schedule, the plant should now be turning out power. The building of this 60,000-hp. plant, besides adding an attractive feature to the industrial life of Bellows Falls, will, in all probability, be the means of stimulating manufacturing activities at that point on the Connecticut River. But even if such be not the immediate consequence, the plant will be the medium by which energy for a multiplicity of purposes will be provided for New England users—every kilowatt representing a corresponding saving in coal that otherwise would have to be carried long distances from mines lying outside of the New England States. This is an economic gain; a public service which the people of New England will surely appreciate.

Air-operated CC-35 pile drivers were used effectively in driving sheet piling for cofferdams.

COMMERCIAL BRIQUETTING OF CANADIAN LIGNITE

AFTER almost a decade of research work, the labors of the Lignite Utilization Board—formed in 1918 by the Canadian Government to devise ways and means to make use of the enormous lignite deposits in Saskatchewan and Manitoba—have been brought to a successful conclusion.

A practical process has been developed for the production of carbonized lignite briquettes for household consumption; and the plant at Bienfait, in the Province of Saskatchewan, used by the board in its experimental work, has been taken over by private enterprise. The plant is to be remodeled for the manufacture of lignite briquettes on a commercial scale.

NATURAL VENTILATION

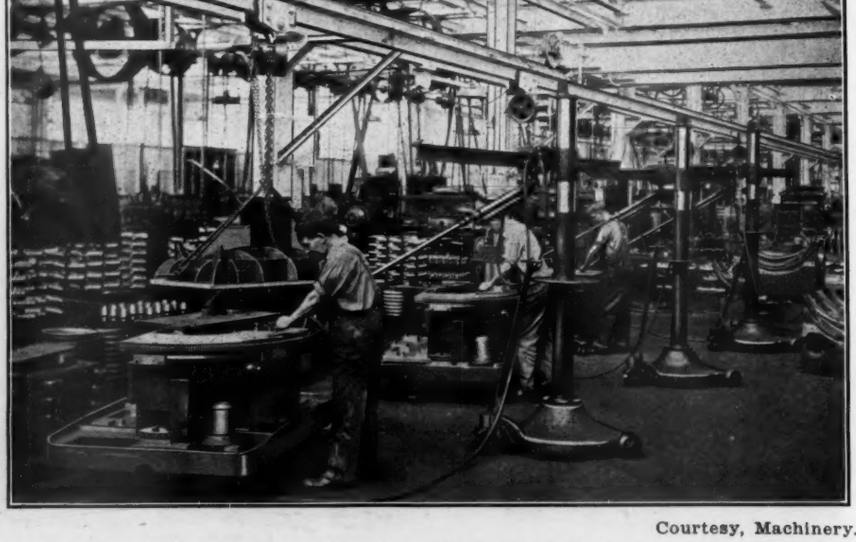
EXPERIMENTS in this field have proved that when all visible chinks in a room are closed a fire in that room will burn well and, furthermore, that some thousands of cubic feet of air will continue to pass up the chimney every hour. Prof. Leonard Hill has found that natural ventilation on a cold day will maintain a flow of air ample enough to secure chemical purity in a dugout of 900 cubic feet capacity, lighted by three candles, and accommodating 30 soldiers. During this test the two exits of the dugout were blocked with double anti-gas curtains.

It will interest the traveling public to know that there are about 500 linear feet of crevices along the doors and windows of a sleeping car through which air can enter. If these crevices averaged one-fiftieth of an inch in width and admitted air at half the rate of speed of the train, then the occupants could count on 40,000 cubic feet of ventilating air.

PNEUMATIC SCRAPERS SAVE TIME AND LABOR

UNDER existing conditions, speed of production commensurate with good workmanship is demanded sooner or later in every department of industry. This urge to maintain output, without adding to the force or bringing added pressure to bear on the men already engaged on a certain job, made itself felt in the department of a plant where it was the practice to scrape the bearing surfaces of machine parts by hand. As can be appreciated, production depended largely on the human factor: fatigue sometimes appreciably lessening the daily output.

This element of uncertainty is no longer a source of annoyance at the plant of the Gleason Works, Rochester, N. Y., where dependable compressed air instead of variable man power is now utilized to operate the scrapers. As our illustration shows, each man is provided with a portable 3-wheel truck on which is mounted a vertical post carrying an adjustable I-beam. The pneumatic scraper is suspended from a trolley traveling back and forth on this I-beam—the beam being long enough to enable comparatively large surfaces to be covered easily without shifting the truck. The needful compressed air is supplied through flexible hose tapping the main air line of the shop.



Courtesy, Machinery.

Turntables and air-operated tools make relatively light work of scraping machine parts in this up-to-date plant of the Gleason Works.

Tempelhofer field, Berlin's great commercial aviation field, is to be provided this spring with something new in the form of a concrete runway, 65.5 feet wide, built around a great ellipse. From north to south, the minor axis of the ellipse will be about 2,953 feet long, and from east to west—the direction of the prevailing wind—the major axis will be 3,936 feet long. The principal object of the track is to assure a smoother surface for starting and landing; and it is estimated that this convenience will cost considerably less to maintain than does the familiar dirt field.

When Ships Carried Ice of Nature's Making to Distant Countries

By C. H. VIVIAN

MODERN inventive genius and mechanical ingenuity have made it possible for us to hear the tinkle of cooling ice in our glasses regardless of clime or season.

The Ingersoll-Rand combination of the Diesel engine and the ammonia compressor has given us a compact refrigerating machine that produces a ton of ice for a fuel-oil cost of only 25 cents. Ice has become a standard commodity that is delivered daily from door to door. Four hundred and fifty million dollars worth of it was sold in the United States alone in 1927. The nation's per capita ice consumption has more than doubled in the past ten years, and now exceeds half a ton for the country as a whole.

This refrigerant preserves foods and safeguards health in 12,000,000 homes, 2,000,000 of which use it the year round. The ice box is cited by medical authorities as one of the most potent influences in reducing the rate of infant mortality. It is because of ice that the American dinner table displays fruits and fresh vegetables in all seasons.

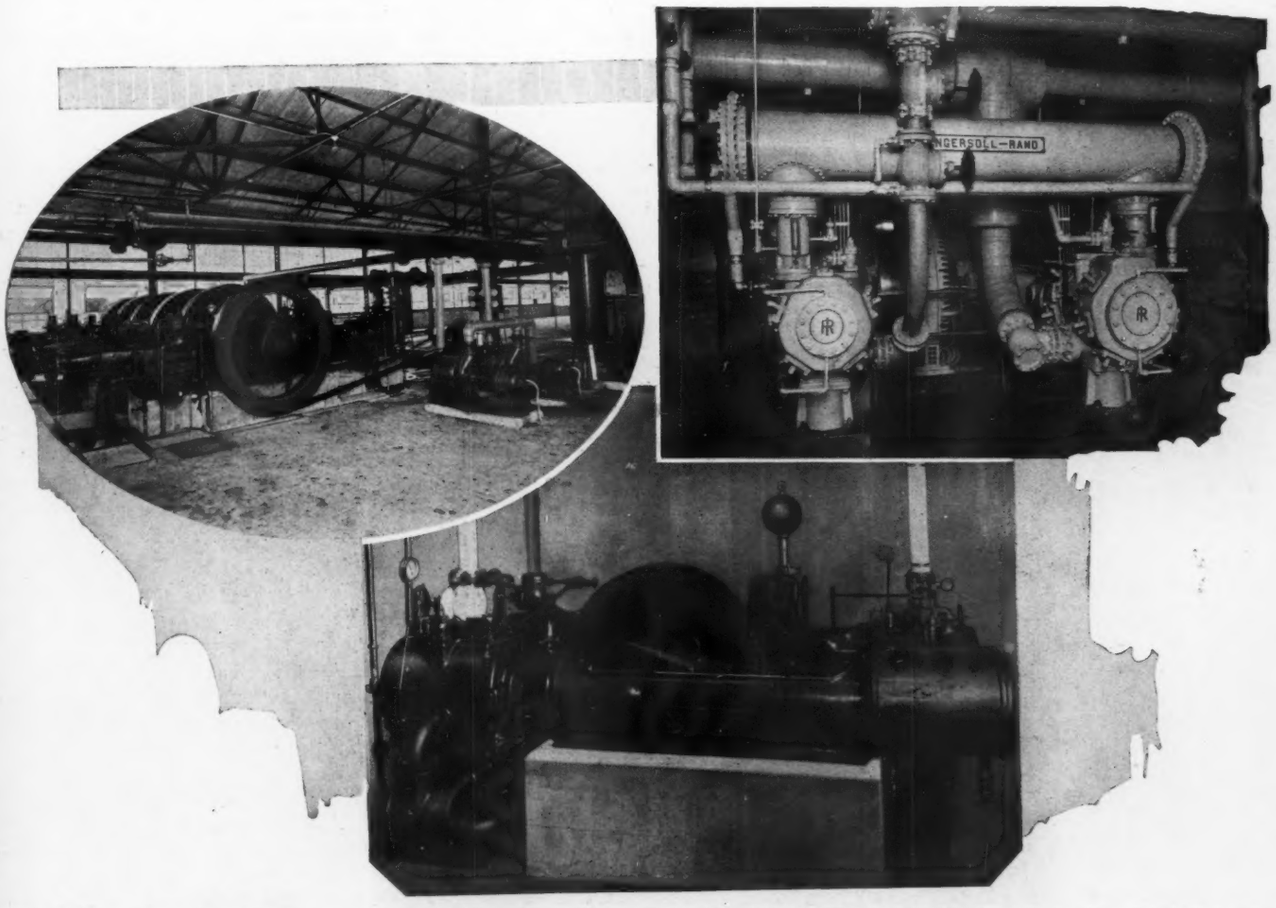
In the light of these facts, it seems unbelievable that less than a century ago there was no manufactured ice; that natural ice was available only to those who lived in or near cold regions; and that it was so totally unknown to many peoples of the world as to completely awe them when they first saw and handled it.

In his *Maritime History of Massachusetts*, Samuel Eliot Morison pictures the bewilderment of the East Indians when the sailing vessel *Tuscany* landed a cargo of this mysterious "white stuff" at Calcutta. The natives placed their hands on the frigid blocks, hastily withdrew them when they experienced the sensation of cold for the first time, and excitedly jabbered questions at the captain of the ship. "How this ice make grow in your country?" they queried. "Him grow on tree? Him grow on shrub?" They bought of it in such quantities as their limited funds would permit, and then indignantly demanded their money back when purchases left in the sun melted away.

Ice was introduced into tropical countries by Frederic Tudor, a venturesome Yankee who thus exploited the frozen surfaces of various lakes near Boston. It took him 28 years to establish the business, which involved him in debt to the sum of $250,000; but in the end he scored success.

Tudor was but 22 years old when he proposed shipping ice from his father's pond at Saugus to the West Indies. His idea was ridiculed; and, because they feared such a cargo would melt and swamp a vessel, sailors were loath to handle his brig. In 1805 his initial venture, a shipment of 130 tons of ice to Martinique, was a complete failure.

But he persisted and, as written by Mr. Morison, "by 1812 he had built up a small trade with the West Indies. The war then



Oval—Three oil-engine-driven ammonia compressors of the POC-1-A type in a Florida ice plant.
Right—One of three electrically driven ammonia compressors providing refrigeration in a big cold-storage terminal in Philadelphia.
Bottom—This ammonia compressor, driven with steam, is the refrigerating unit in an ice plant in Knoxville, Tenn.

wiped him out. After the Peace of Ghent, he obtained government permission to build ice houses at Kingston and Havana, with a monopoly of the traffic. It began to pay, and between 1817 and 1820 he extended the business to Charleston, Savannah, and New Orleans."

The pioneering of the ice industry was accompanied by numerous difficulties. Vessels had to be double sheathed, lest the cargo melt. Various sorts of insulators were tried out as a packing material for the cakes before pine sawdust was found to be the most suitable.

Since the inhabitants of the warm regions did not know what ice was or how it would serve them, there was no demand for it until Tudor had taught them how to use it. At times he gave it away to popularize cold drinks and thus to build up a market. In Rio de Janeiro his agents promoted an ice-cream establishment to acquaint the people with that delicacy. Elsewhere they had to instruct their customers in the art of preserving ice in the home. This was carried to the point of importing materials and constructing ice houses.

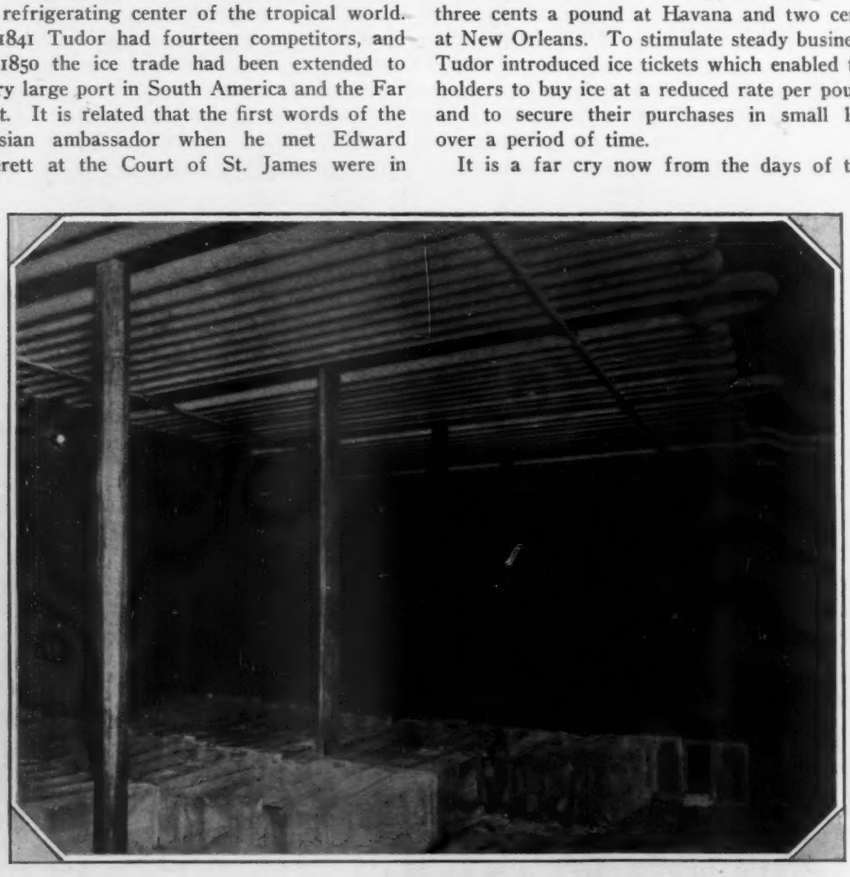
It was in 1833 that the *Tuscany* took the first shipment of ice to Calcutta, after twice sailing across the equator. While the poverty of the natives prevented them from buying extensively, the Anglo-Indian community took avidly to iced drinks. It also paid high prices for Baldwin apples that had been transported buried in the cargo.

From this beginning, Massachusetts became the refrigerating center of the tropical world. In 1841 Tudor had fourteen competitors, and by 1850 the ice trade had been extended to every large port in South America and the Far East. It is related that the first words of the Persian ambassador when he met Edward Everett at the Court of St. James were in appreciation of the benefits of American ice in Persia. Until manufactured ice made its appearance in the "eighties," the trade expanded and every New England pond near tidewater contributed to it.

Tank room of a well-equipped raw-water ice plant. Beneath the floor are the circulating brine and the cans in which water is turned into cakes of transparent ice.

The prices to the consumers varied widely, according to the distance from Boston and the extent of competition. In Rio de Janeiro the first shipment was sold at the rate of 12 pounds for a Spanish dollar. In 1834 the charge was three cents a pound at Havana and two cents at New Orleans. To stimulate steady business, Tudor introduced ice tickets which enabled the holders to buy ice at a reduced rate per pound and to secure their purchases in small lots over a period of time.

It is a far cry now from the days of this intrepid Yankee ice baron. Today, artificial refrigeration is utilized in every civilized country on the globe; and one would have to penetrate the fastness, for example, of the African jungle to find a people who are unfamiliar with ice and its many beneficial uses. By means of efficient ice-making machines, such as are shown with this article, the price for the man-made commodity has been reduced to a small fraction of that which the natural product from the New England ponds commanded. Thus has Nature once more given way before human contriving!



Refrigerated storage room of a modern ice plant, partly filled with hundreds of glistening cakes weighing on an average about 300 pounds each.

A PULLMAN POSER

A MAN asked a Pullman agent for a berth. "Upper or lower?" There's a difference in price. Let me explain:

"The lower berth is higher than the upper. The higher price is for the lower. If you want it lower you'll have to go higher. In other words, the higher, the lower. Most people don't like the upper, although it is lower on account of its being higher. When you occupy an upper you have to go up to go to bed, and get down when you get up. You can have the lower if you pay higher. The upper is lower than the lower because it is higher. If you are willing to go higher, it will be lower."

"Guess I'll go to the settin' car," replied the man who thought he wanted a berth.—*The Kalends.*

An agreement has been reached by the governments of Portugal and Spain by which the Douro waterfalls are to be harnessed for the benefit of the adjoining countries. These falls are situated at a point in the Douro River where that stream divides Spain from Portugal. According to the United States Consul at Oporto, a treaty has just been signed by the two nations that entitles Spain to 340,000 hp. and Portugal to 285,000 hp. of the block of electric energy that is to be generated by the proposed hydro-electric plant.

Pneumatic Vibrator Assures Better Reinforced Concrete

By A. S. DOUGLASS*

WHILE watching concrete being placed in a heavily reinforced floor structure, it was observed that the men used the spading bars and tamps to strike the reinforcing metal in order to cause the concrete to flow around and beneath the bars, which were closely spaced in the bottom of the beam boxes. The jarring action imparted to the reinforcing by those blows caused the whole mass of concrete in the beam box to flow toward the unfilled end.

On seeing this, it occurred to the writer that if the reinforcing steel could be vibrated by an air hammer while the concrete was being placed the steel would become thoroughly embedded in the concrete—thus insuring contact between the two materials and, as a result of that perfect bond, greater protection to the steel. Further, it was evident that if all the concrete could be placed in one end of the beam box—the entire mass caused to flow forward as the box was being filled—this movement would tend to prevent honeycombing at the surface of the concrete while the vibrations would serve to compact the concrete and to expel air and excess water from the mass.

Some special steel tamping bars were subsequently made for use with standard riveting hammers, as shown by the accompanying photographs. The dressed end of the bar is in the form of a saddle so that it will ride on top of the reinforcing rods. By moving the point of this bar from rod to rod in the beam box, the steel is kept vibrating all the time the concrete is being placed. The results obtained with this device have been decidedly satisfactory.

Using the riveting hammer and tamping bar to vibrate the reinforcing steel during the placing of concrete so as to prevent the formation of air pockets in the concrete.

Besides bringing about an intimate bond between the concrete and the reinforcing steel—which can be clearly seen in one of the pictures at the point where the steel projects beyond the enveloping concrete, honeycombing has been greatly reduced and the amount of spading labor lessened. Experience has proved that this air-operated vibrator, when used in connection with properly proportioned plastic concrete, can be counted upon to distribute the mass more evenly and thus to place it more effectively than otherwise would be the case.

Construction Engineer, The Detroit Edison Company.

Air-driven riveting hammer and tamping bar used to cause concrete to pack firmly around reinforcing metal when erecting reinforced-concrete structures.

GUAYULE RUBBER PROMISING

A PUBLICATION of unusual interest especially to the automotive industry has recently been issued by the United States Bureau of Standards. It is entitled *Some Vulcanization Tests of Guayule Rubber,* and gives the results of certain physical tests made by that bureau with samples of guayule rubber from a shrub grown in both Mexico and California.

The results indicate that properly prepared guayule rubber will compare favorably with cultivated Hevea rubber. The use of guayule in place of Hevea rubber would prove of great economic value to the United States, as the shrub from which it is produced can be successfully grown in Mexico, in California, and in the southwestern part of the United States.

By occasionally greasing the overhead wires of electric cars in the cold months, any sleet that may tend to accumulate on them is readily knocked off by the passage over them of the trolley wheels. Besides lessening arcing, it has been found that by the use of grease the wear of the wires on curves is reduced by about 60 per cent. The experiments were conducted in Toronto, Ont., where ice-laden wires were a great source of trouble in the wintertime.

Abuse of Air Tools

By J. D. CLAGHORN

THE use of compressed air, in its numerous applications and through the agency of scores of different machines and tools, has increased more since its introduction into the mechanical field than the use of steam increased after the invention of the slide valve, in fact, over a hundredfold.

Indeed, it has come into such common use that in many large engineering plants and factories nearly all the operatives either employ air tools of one kind or another or see utilized continually motors large and small for drilling, reaming, countersinking, stay-bolt tapping and driving, boiler-tube beading, and for divers other purposes. And air hammers—no end of them, from the husky 9- or 11-inch gun, that heads up hundreds of 7/8-inch or 1-inch rivets a day, day after day, without a moment's loss of time and with a minimum of care, on down to the tiny "pistol" scaling gun—not to mention the long and steadily increasing line of jacks, holders-on, rock drills, rammers, busters, and cement and coal picks, as well as the handy and profitable grinders and steel brushes.

Driving flush rivets in a rotary dryer with a No. 8-A riveting hammer.

Workmen see them everywhere. There, for example, lies a motor or gun already attached to a hose or leader, and Tim Murphy grabs up the gun that Mike Mahallivitch has dropped for a minute, and no questions asked, while Mike goes to give Joe Smith a hand with a stay-bolt motor. The lot of them in machine shops, boiler shops, erecting plants, and shipyards have become so accustomed to the sight of those sturdy, dependable tools—which are so adaptable, so ever ready at hand—that the men have got the idea that they require no care; and, as far as they are concerned, none is given.

Now, as a matter of fact, there are no tools comparable with air tools in the matter of service given. For instance, observe the air drilling motor with its accurately built and perfectly balanced working parts: a 4-cylinder engine, usually, with its throttle valve in its handle and with spindle speeds of from 60 to 1,500 revolutions per minute, according to size and type, and permitting the use of drills from 1/16 inch to 2 inches or even larger on work placed in almost any position.

And then the pneumatic riveting hammer: the first and only improvement over the time-honored hand riveting hammer now almost forgotten save by a few old Belfast or Clydebank "shellbacks" who found it so hard to accept the new order of things in steelcraft. As for chipping hammers, there are thousands of workmen who have never known any other method of chipping and calking than with air. I doubt if any other air-driven tool—except perhaps the pneumatic rock drill—has shown such profitable returns on the purchase price.

We might go on extolling air tools almost indefinitely—tools, which in design are triumphs of American ingenuity, and in construction masterpieces of machine-tool work. They are built to stand up under the most exacting service, very often beyond their rated capacity; and are universally abused beyond the strain that anyone would suppose they could work under. Were it not for this abuse they would yield a surprisingly greater return on their purchase price.

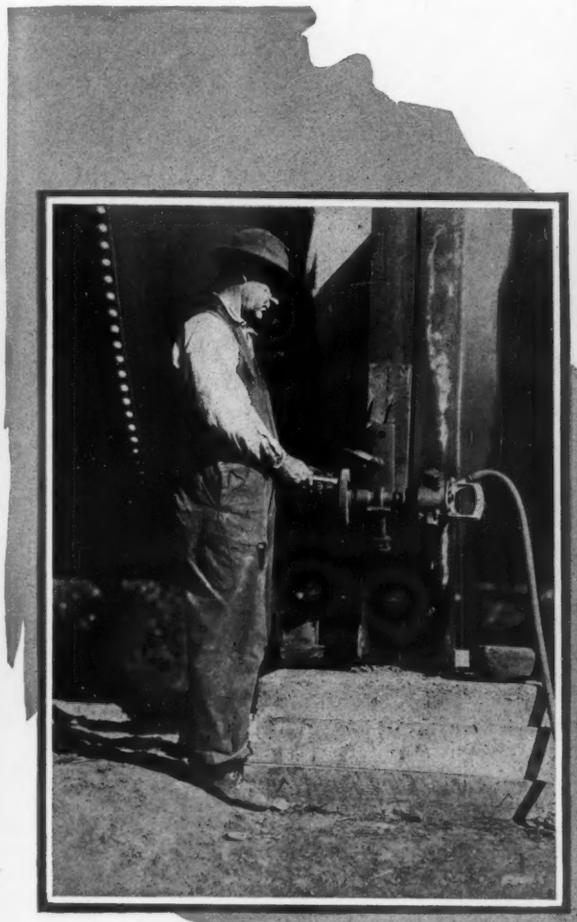
The origin, I think we might say, of the greatest damage done to the working parts of motors and air guns may be found in the compressor, or, rather, in the air delivered by the compressor, for not by any means do all users of air tools appreciate the actual necessity of clean, dry air. Until the advent of the air filter, dirty, gritty, moist air had been the cause of thousands upon thousands of dollars being spent in needless repairs on air tools, and on none more so than on the compressor, itself, especially that of the portable type.

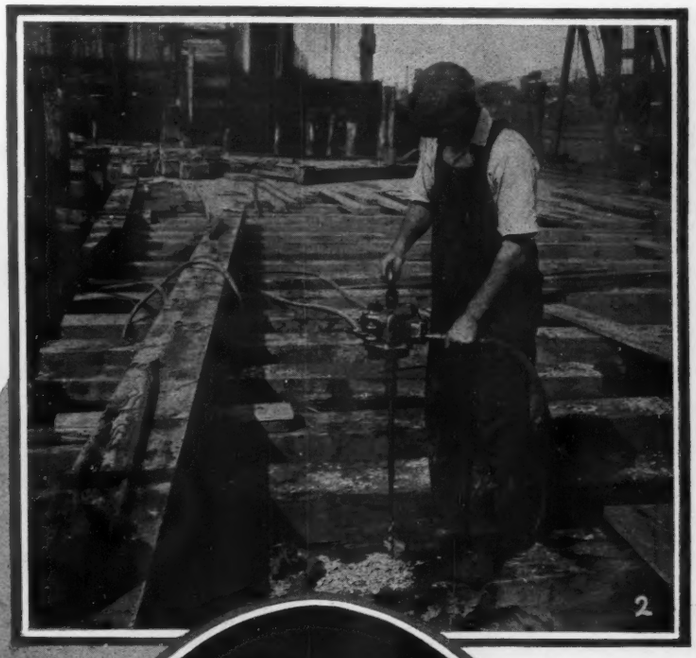
One can hardly believe that a superintendent of construction, or whoever is responsible for upkeep of equipment, would be guilty of failure to protect a compressor from the air-borne dust ever present in quarries, most coal mines, and in all arid districts. This last field covers a multitude of big jobs, often compelling the employment of several portable compressors each; and in the majority of cases at points where repairs are made at a disadvantage and repair parts are not readily obtainable.

Too many engine and compressor tenders still hold to the belief, seemingly, that all the protection an intake needs is a screen of 1/4-inch mesh to prevent small sticks, wads of paper, and coarse sweepings from entering. The wonder is that so many compressor men still seem to be at a loss to account for the condition of rotary valves. One with whom I used to swap experiences told me, in all seriousness, that he thought the trouble was dirty oil. The intake of his machine was on a narrow alley, because the alley was "cool and shady." But it was also unpaved and surfaced with fine gravel and clay and dry nearly all the time. As trucks passed through a score or more times a day, the air was filled, more often than not, with gritty dust.

I am not attempting to boost the sales of air filters, although I am

This air-driven, close-quarter drill is a handy tool for work in awkward places.





1—Handy set-up of an air-driven grinder.
2—The pneumatic woodborer is a great labor-saving aid in timberwork of all sorts.
3—Pneumatic sand rammers are now considered indispensable in any well-equipped modern foundry.
4—A gang cleaning riveted steelwork with air-driven wire brushes.

**Left—The pneumatic wire brush is an effective tool in removing rust and thin scale from water mains, etc.
Right—The air-driven clay digger makes relatively light work of excavating in stiff ground and in some kinds of rotten rock.**

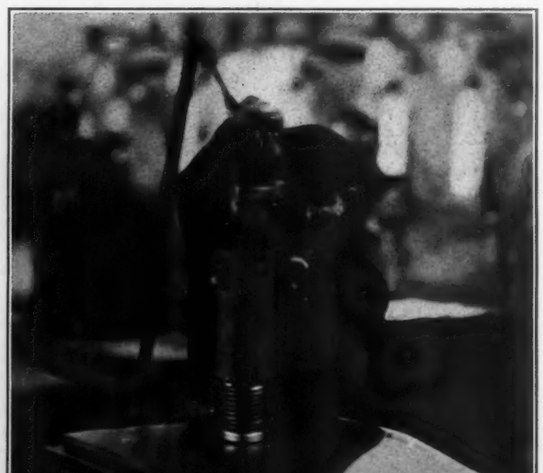
strongly advocating their employment as the only known means by which dirt and moisture in air may be eliminated. After such a long period in which pistons and valves have been scored by air-borne abrasives, and beautifully fitted valves and motor pistons have been corroded to the seizing point by dirt-laden water, it does seem that a good and reliable means of preventing these abuses could not fail of appreciation by all users of air-driven machines and tools.

But of what value is clean air delivered by the compressor if no care is taken to keep dirt out of the hose and leaders? I have seen literally hundreds of instances where open hose ends have lain on dusty, dirty, and even sand-covered floors, ready to be hooked up to motors and guns without a thought of being blown out before connecting. Indeed, it is common practice, or, rather, common abuse.

Motor and gun valves require regular inspection in order that impending trouble may be caught in time; but with clean air, and regular, systematic oiling with the right kind of oil, the time needed for taking apart for inspection may be reduced greatly. Of course, the utilization of a known, valued oil is a positive requirement; and as oils are made especially for certain uses, and are guaranteed to give specific results, there is mighty little excuse for improperly lubricated machines and tools. There are still many persons to whom oil is just oil, and "about as good as any other," except, perhaps, when grease is called for as in a motor crank case.

Quite recently the foreman of a steel-construction company was heard to remark that "it didn't make any difference what kind of oil was used in riveting and in chipping guns—it blows right through, anyway." Now, it is a well-known fact thatbreakdowns is the failure to keep the crank an oil of good quality, preferably one madecase supplied with the proper kind and the for the purpose, will remain for quite someright amount of grease and case covers and time in the valves and around the plunger ofspindle stuffing boxes so well fitted that the a riveting or a chipping gun, for if such weregrease cannot escape. Otherwise, by reason not the case it would require oiling everyof a long period of use and loss of grease, a fifteen minutes instead of every two hours,crank case runs dry, and then it takes only a more or less; and guns have been known toshort time for the connecting rod and the work perfectly when oiled once in three hourscrank-shaft bearing to heat and to cut to de- of continual service. struction. If not the worst, this is certainly

One of the most common causes of motorthe worst-looking result of abuse we know of.



When sheets of tin are placed in the annealing furnace it is not an uncommon thing for them to stick together. In this case, a 9C air-driven riveter, equipped with a large-faced rivet set and retainer, is used to separate the annealed sheets by means of vibratory action. This has proved effective, and a means of saving much time and labor.

But there is one form of air-tool abuse that seems to me to be the most inexcusable of all: the rough handling and "banging around" of tools by heedless workmen, and then their clumsy attempts to repair tools "on the job." This last is the bane of the toolroom foreman's existence, for, as a general thing, he has no authority over the offenders who quite often not only take tools apart but, in reassembling them, fail to replace all the parts and, when returning them to the toolroom, declare them to be exactly as they took them out.

As expensive as air tools are, as necessary as their perfect working condition is, and as costly as their abuse is, it seems unbelievable that so little interest is taken in their care by the persons most interested in the financial returns that might be expected from their use. Whether tools are properly cared for or abused is largely a matter of foremanship, although this fact seems to be generally overlooked.

The construction of a $1,000,000 port for the Island of Luzon has been recommended by the Philippine Bureau of Public Works. The municipality of San Ildefonso has been selected as the site of the proposed port.

One of the interesting exhibits at the New York Power Show. In the center can be seen the largest pump ever made for handling boiler feed water. It is a 5-stage Cameron pump that has a capacity of 2,000 gallons per minute against a head of 550 pounds. It is one of four similar pumps to be installed in a steam-generating plant of the Southern California Edison Company at Long Beach, Calif.

New York Power Show

THE sixth National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, was attended by approximately 120,000 persons. There were 530 exhibitors, and four floors of the building were given over to their products.

While the Power Show, as it is familiarly termed, is primarily held for the purpose of displaying the latest mechanisms developed for the generation and the application of power, still the field of heating and ventilating has been represented more prominently year by year. In fact, nearly half the exhibits at the 1927 show were of this nature.

The increased space taken up by appliances of this kind emphasizes, for one thing, the trend in modern industry toward more comfortable and healthful conditions in production plants. These are factors that are now recognized as having direct and beneficial bearings upon efficiency. Adequate lighting also was featured; and some of the exhibitors exploited illuminating equipment which demonstrated that the modern factory can perpetually be kept "sun bright" regardless of prevailing weather conditions and of the form of building construction adopted.

The exposition revealed much of interest to the general visitor. A display of animated mechanical models, that showed by sectionalized devices the various principles by which power is applied in mechanical fields, proved of educational value to all. It consisted of 240 separate and distinct models, all motivated from behind the panels on which they were mounted.

Several exhibits disclosed what is being accomplished in providing for the safety of workmen. Steel guards to protect feet; respirators for workers in dust or spray; goggles for different industrial purposes; and numerous other articles of similar utility were displayed. Of popular appeal was an entire suit of asbestos, intended for men working around open flames or in places of great heat, as well as for firemen.

Several of the latest types of aeroplane motors attracted considerable attention. The casual visitor also found much to interest him in a torque amplifier for automobile steering mechanisms. This utilizes power from the motor to assist in backing or turning a car when parking it, thereby relieving the driver of muscular exertion. Another new exhibit that received more than passing notice was a crankless gasoline engine.

Several devices were shown for properly conditioning compressed air in industrial plants. Among these was the Gast separator, which is designed to remove oil and moisture from the air in the lines. The Staynew Filter Corporation demonstrated the action of the Protectometer, a compact filter for cleaning intake air.

Different from most types of compressed-air apparatus was an air lock of the sort used in connection with caissons utilized when excavating in wet ground. The displays also included "air guns" used for placing refractory linings in furnaces.

A concession has been granted by the Government of Venezuela for the construction of a railway from any point on the right bank of the Orinoco River below the port of San Felix to the El Callao gold fields in the State of Bolivar. The Orinoco terminal is to be provided with docking facilities for ocean-going vessels. The cost of the undertaking is estimated at $2,500,000.

AMMONIA-COMPRESSOR PLANT COOLS AIR IN HOSPITAL

A COOLING system of considerable interest to refrigerating engineers and to the medical profession, according to *Ice & Refrigeration*, has been installed in the County Hospital at Shanghai, China. That city is situated on approximately the same parallel of latitude as Cairo, in Egypt, and has a mean daily temperature of 90°F. with a humidity during June, July, and August averaging 80 per cent.

To assure the comfort of the patients, even when the temperature reaches 103°F.—as it does at times—it was found expedient to provide a system of drying and cooling the air in the hospital. The equipment used for the purpose consists of an electrically driven ammonia compressor of 16 tons capacity. This compressor is run daily from 9 a. m. to noon and from 2 p. m. to 4 p. m. On occasions, when operations are being performed, it is kept going to 6 p. m.

This refrigerating plant is employed to chill water which, in its turn, serves to cool the air admitted to the different rooms. The chilled air is forced into the rooms through narrow slits that are so disposed just below the ceiling that the incoming air is directed upwards toward the ceiling. After months of service, it has been proved that no moisture is precipitated within the sick rooms even when the humidity outside is very high, and that no harmful draughts are induced. The hospital management is said to be well pleased with the system. In fact, it attributes the successful treatment of some especially serious cases to the workings of the air-cooling plant.

ROAD SHOW OF 1928

THE annual exhibition of roadbuilding and excavating machinery, which is commonly known as the Road Show, was held during the week of January 9 at Cleveland, Ohio, in conjunction with the twenty-fifth Annual Convention of the American Road Builders' Association.

The displays were housed in the Cleveland Auditorium; and because greater space was available there than has been obtainable in years past in Chicago, more equipment was shown than ever before. The exhibition included the latest types of every sort of tool and machine devised to aid in the now tremendous business of building and maintaining highways.

The Road Show seems to grow in popularity with each succeeding year. This has come about not only because of the phenomenal increase in highway construction but also because the show and its attendant meetings are directly under the supervision and management of those persons who are closest to and most directly concerned with the industry being exploited.

The convention program was carried out in the Hollenden Hotel, and included carefully prepared papers and discussions on a variety of subjects bearing on highway construction and maintenance. One day was designated the Pan-American Day, and was given over to a consideration of the problems that especially concern the Latin-American countries, which were well represented. Another day was devoted to matters of primary interest to county highway officials. Papers were read by delegates from eight standard committees who are studying the field from that viewpoint.

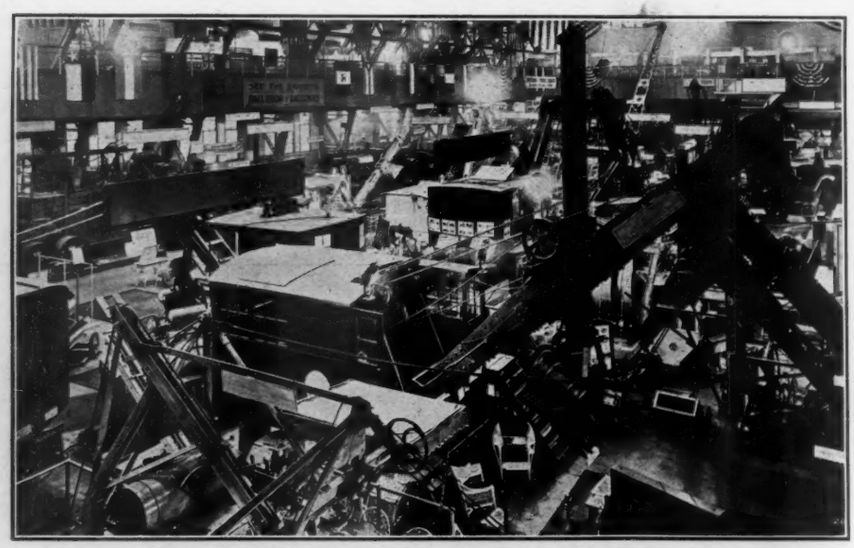
Because of the augmented enrollment of the American Road Builders' Association, the membership has been divided into five groups: engineers and officials, highway contractors, county highway officials, equipment manufacturers, and membership at large. This makes it possible for a group or groups to hold supplementary programs having to do with subjects of outstanding importance to their own members, and also to conduct a part of the general sessions.

The opening day was set aside as Manufacturers' Day. At that time, factory representatives of exhibiting companies explained their newly developed products to visiting members of distributors' sales organizations from various sections of the country. Throughout the week there were special sessions covering a diversity of subjects; and the convention was rounded out with numerous social events. Outstanding among those functions was the annual banquet, at which the delegates from the Pan-American countries were guests.

The program was coördinated by Mr. H. K. Bishop of the United States Bureau of Roads. He was assisted by Mr. Frank Sheets and Mr. Fred White during the engineers' sessions, and by Mr. S. M. Williams and Gen. R. C. Marshall during the contractors' sessions. It was notable that the convention discussed not only all phases of roadbuilding and maintenance but also the broad problems of controlling highway traffic.

Photo by Webster & Stevens, Seattle.

The little Miss in the picture is Betty Nevenner of Seattle, Wash. Having just brought her father's mid-day meal to him, she rests for a time upon his lunch box and supervises his work. Her father, W. J. Nevenner, is engaged in breaking away the pavement to reach some Western Union conduits.. He is running a CC-35 paving breaker.



A typical Road Show display of the machinery that helps to move mountains of material so that man may travel in comfort over the country's highways.

PAPER MILL IN THE PUNJAB

WITH the laying recently of the corner stone of the Punjab Pulp & Paper Mills at Jagadhri, India, definite steps were taken toward the establishment in the Punjab of a pulp and paper industry. Orders for the mill machinery have already been placed; and, when finished, the mill will be one of the most up to date in the Far East.

The initial capacity of the plant will be 7,000 tons of white printing and writing papers and 500 tons of wrapping paper per annum. *Sabai* or *bhabbar* grass, which grows there in great abundance, will form the raw material. A force of from 500 to 600 men is to be continually employed, and this force is to be brought up to several thousand during the grass-cutting season, which lasts from October to May.

In a paper read before the South African Institution of Engineers, Mr. E. S. Laschinger —we learn from a recent issue of *The Engineer* —suggested that "one means of improving atmospheric conditions in the working places of deep mines would be the local compression, cooling, and re-expansion of a portion of the ventilating air. In re-expanding, the air would help to drive the compressor; and in the process the air would be dehumidified. For an expenditure of about 81 hp. a supply of 1,000 cubic feet of cold, dry air could be provided per minute."

Some Diesel-Engined Tugboats In Use On the Pacific Coast

By C. A. BERST

THE towboat fleets of the Pacific Northwest are probably the most modern in the world. While larger centers, such as New York Harbor, may have a greater number of vessels, nowhere is the equipment more up to date than in the Puget Sound territory.

Several factors have brought about this condition. In the first place, the service performed by the towboats is extremely diversified, and calls for many variations in the types of vessels employed. The lumbering, fishing, and paper-pulp industries, as well as general harbor work, involve activities that often require specialized equipment. Long-distance towing, frequently reaching far into British Columbia or even Alaska, makes necessary boats of unusually large fuel capacities. In the second place, competition is very keen. Although the amount of available work is large, the number of bidders is such that the company whose boats are best fitted to handle the job wins out. Obsolete equipment is, therefore, quickly discarded in favor of the very best the market affords.

One result of this demand for superlatively up-to-date craft has been the astonishing development in the use of Diesel-powered vessels. While some sections of the country still regard the Diesel engine as more or less of an experimental proposition, the Pacific Northwest has adopted it almost without reservation. This is true not only of towboats but practically of every line of boats.

The companies were quick to realize the advantages of the oil-engine tug in the form of operating economy, efficiency, freedom from trouble, and long life. Substantially all the new tugs being built on the West Coast are installing Diesel engines; and the older boats of steam, gasoline, or distillate power, are rapidly being converted to Diesel power.

The Foss Company of Seattle and Tacoma, Wash., was among the first of the big companies to visualize the coming importance of the Diesel engine, and was a pioneer in applying it to towboat service. This company is today the largest operator of Diesel tugs in the United States. Sixteen of its fleet of 32 vessels are of the new type; and seven 500-hp. Diesel engines were recently purchased for use in additional craft and in converting old boats that now are driven by steam or gasoline power.

Two of this company's most interesting conversions are the tugs *Martha Foss* and *Foss 21*. Both boats were steamers before coming under the Foss flag—the *Martha* having been the *Dolphin* of the Killisnoo Packing Company of Alaska, and the *Foss 21* the steam tug *Fearless* operated for many years by the Tacoma Tug & Barge Company. After purchase by the Foss interests, they were completely rebuilt and equipped with Ingersoll-Rand 240-hp. Diesel engines of the PR type.

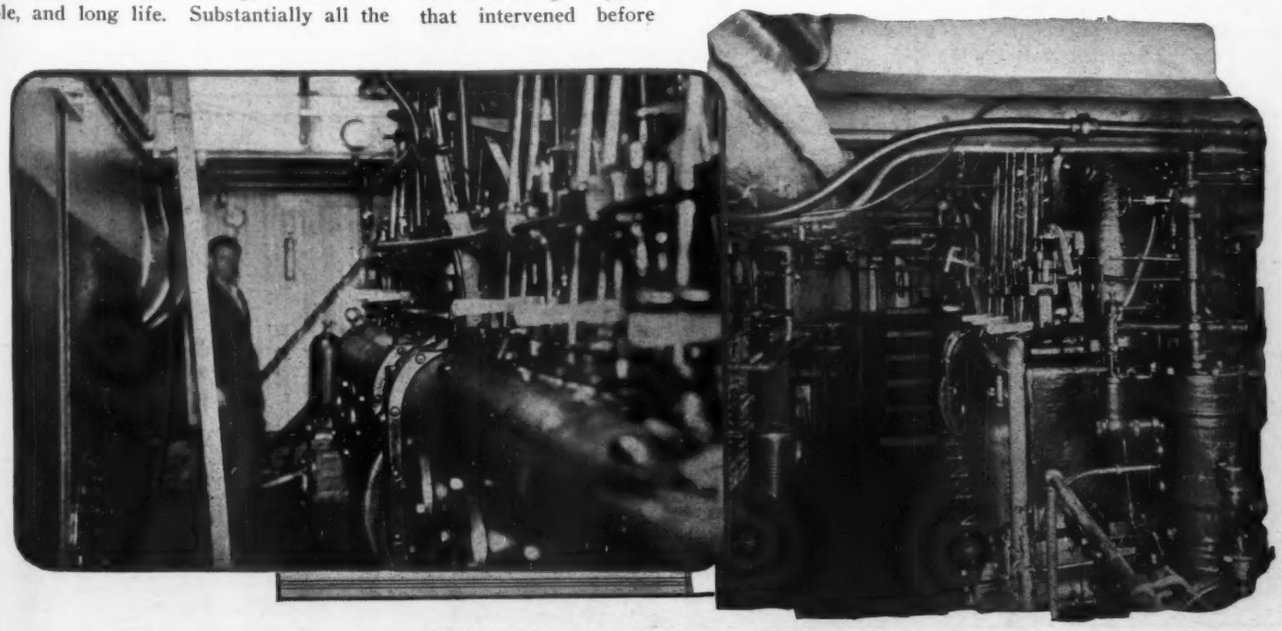
The history of these engines prior to their acquisition by the Foss Company is worth recounting. These two units were originally bought by the French Government during the war period and shipped to China for installation in French vessels. The termination of the war interrupted this plan; and the engines, still in their factory cases, were left in China. During the years that intervened before their purchase by the Foss Company, they were entirely neglected. They passed through several insurrections; and, according to Mr. Arthur Foss, were used as barricades by the contending factions. Some of the cases were spotted with blood.

Upon reaching Seattle, the engines were still in the original cases; but they had been so well packed at the factory that not the slightest damage was found. Guided only by the instructions that accompanied the shipment, the Foss crew assembled them and put them in running order.

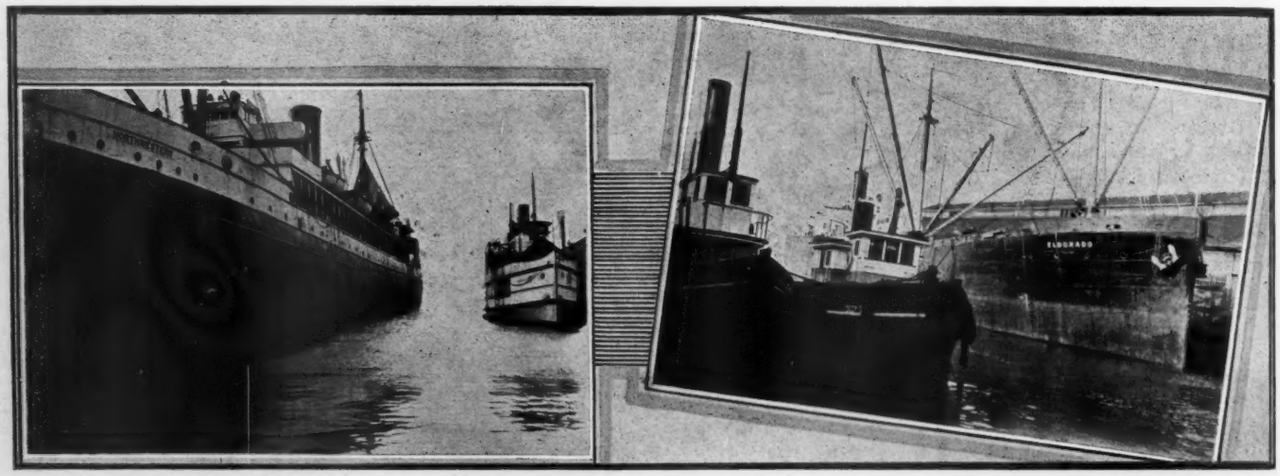
The PR Ingersoll-Rand marine engine operates on the 4-stroke cycle and is of the solid-injection, single-acting, trunk-piston type. It employs the well-known Price system of fuel injection that supplies oil to each cylinder through two diametrically opposed nozzles, which act in such a way as to produce a highly turbulent spray in which there is an almost perfect diffusion of oil vapor and air.

Among other advantageous features of this engine is the main bearing which is of such a type that the lower half is supported by a wedge block which is adjusted by two wedge bolts extending outside of the engine base. As the main-bearing cap is bolted rigidly to the base and as it does not wear, the maintenance of perfect alignment of the crank shaft is assured. Also, the lower half of the main bearing may be removed without disturbing the crank shaft.

The most conservative design has been em-



Left—Engine-room of the "Foss 21."
Right—Engine-room of the "Martha Foss."



Types of ships seen in the Harbor of Seattle.

ployed for all parts of the engine. The base is provided with long flanges with ample bearing surfaces. On the base is carried a housing upon which are mounted the cylinders with their heads, and the intake and exhaust manifolds. The cylinders and heads are completely water jacketed. The pistons are of special material, heat treated to prevent warping, and are finished to exact size. All parts are carefully designed to perform their functions with the greatest efficiency, and every precaution has been taken to insure against any possible trouble. The engine, of the type just described, has six cylinders of 13-inch base and 17-inch stroke. It is direct reversible, and attains its 240-hp. rating when running at 240 revolutions per minute.

The *Martha Foss* is 92 feet long, 22 feet wide, and has a draft of 12 feet. She is heavily constructed, with 12-inch frames on 6-inch centers. The hull is stiffened fore and aft by 18x24-inch timbers, which are through bolted to every frame. A 4x12-inch hardwood strip runs along the bottom on each side of the keel. Back of the pilot house is a texas containing the captain's cabin and staterooms for the mate and the engineer.

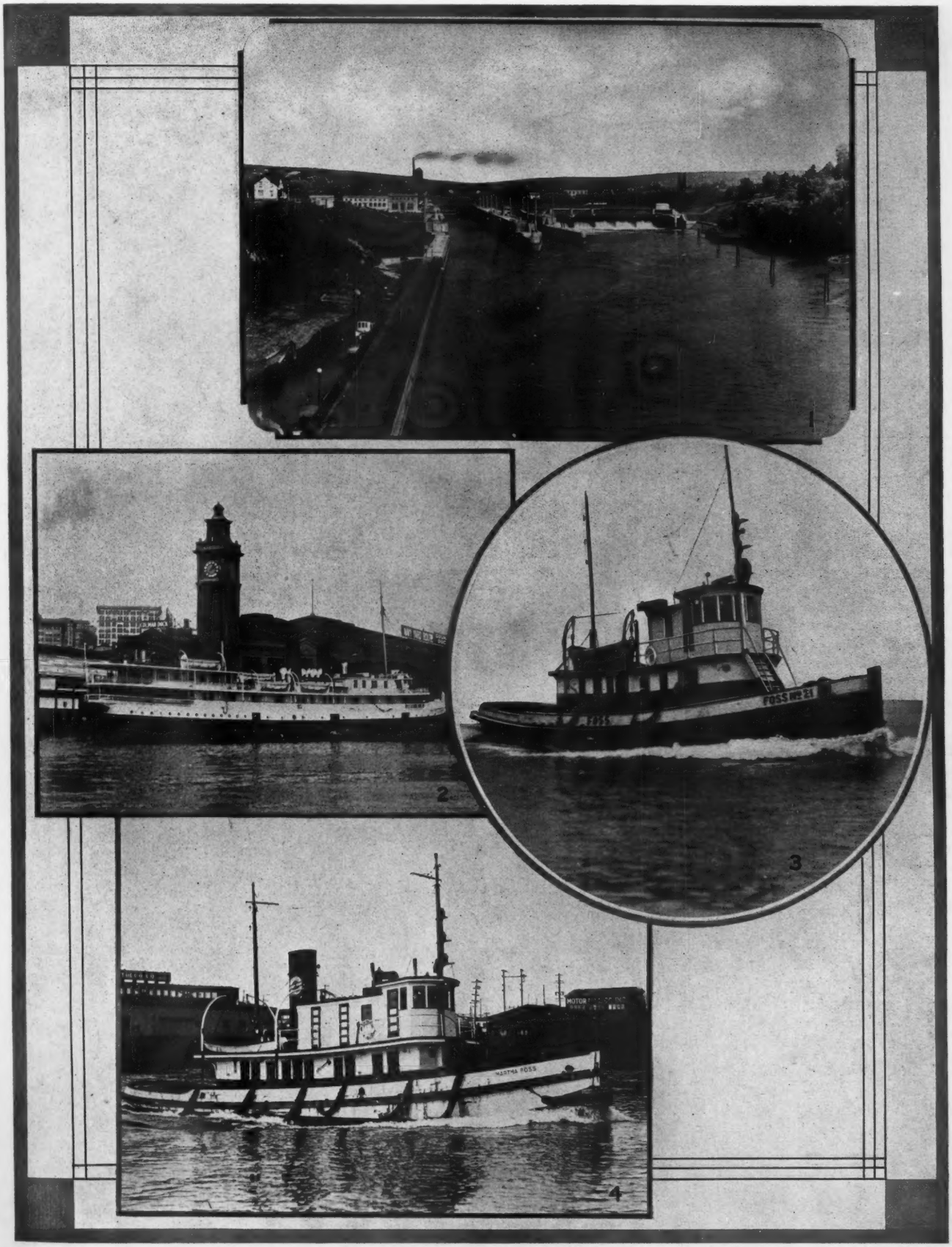
The auxiliary equipment of the *Martha Foss* is unusually complete. A 10-hp. Frisco-Standard distillate engine is direct connected through a 1-way clutch to a 4x6-inch single-stage compressor that furnishes air at 200 pounds pressure for starting the main engine. A 3-inch rotary pump for fire protection and for pumping out scows is driven by a belt from the auxiliary engine. When the boat is underway, current is supplied by a 22-ampere Westinghouse generator which is driven by a belt from the main engine.

By means of a clutch, the main engine drives a 12½x12-inch Ingersoll-Rand single-stage compressor that supplies air at 125 pounds pressure for operating the deck machinery, the pneumatic steering gear, and the pneumatic clutch controls. A feature of the boat is the use of compressed air for the working of the anchor winch and the towing machine. This practice is becoming quite common on the Pacific Coast; and compressed air is competing seriously with electricity in the operation of motor-boat auxiliaries.

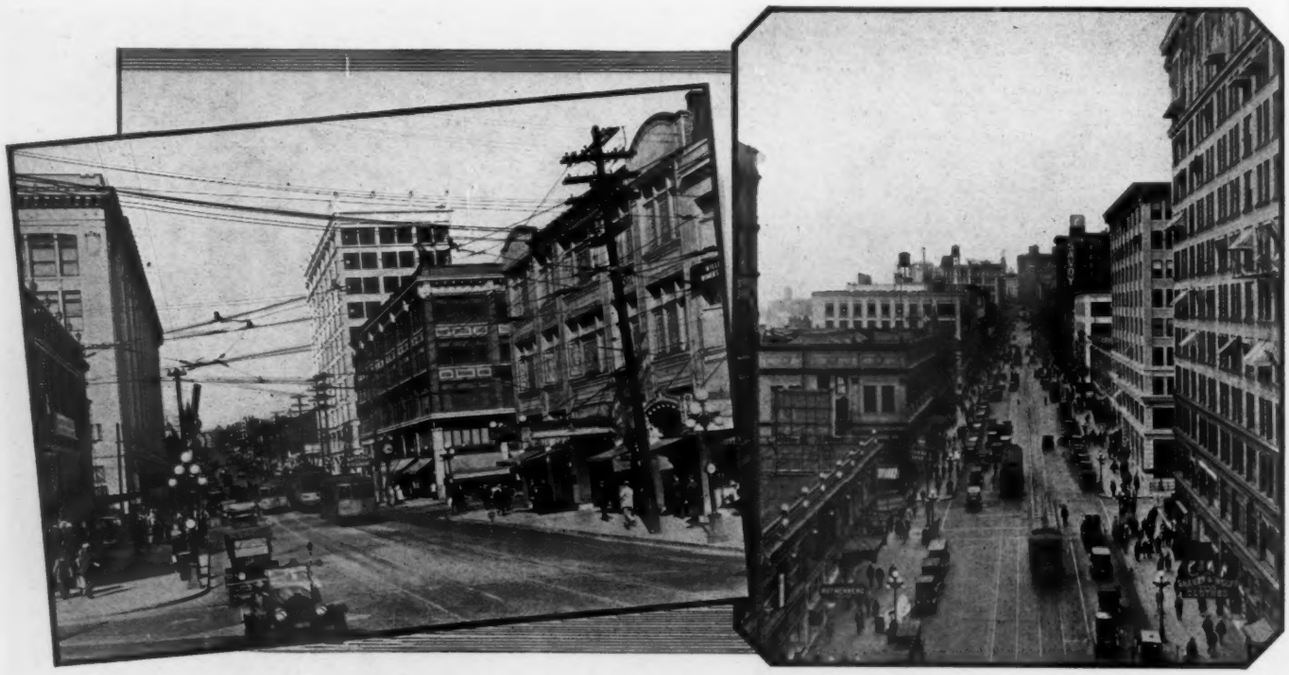
The pneumatic equipment on the *Martha Foss* has proved highly efficient. The anchor winch is a 7x8-inch Hyde steam machine that has been converted to air drive. Operating through a 50 to 1 gear, this winch handles the 1-ton anchor readily; and at one time it broke a 1-stud lock chain on a steady pull, showing the tremendous power that is developed. And yet the consumption of air is very low. The air-driven towing engine is a 5x5-inch American winch that is powerful enough to take care of the lines on the heaviest tow. Operation of the steering gear by compressed air gives positive control of the vessel at all times. Air also serves to actuate the 1-way clutch on the main engine. All Foss boats of the direct-reversible type use 1-way clutches, it having been found that they make it easier to maneuver the tugs in close quarters. The air controls for the clutch and for the steering gear were developed by Glenn Peterson, Seattle port engineer for the company.

The *Martha Foss* has a complete Arcola hot-water heating system. She has carrying capacity for 7,500 gallons of fuel oil, 375 gallons of lubricating oil, and 375 gallons of distillate for the auxiliary engine. The *Foss 21* is 76 feet long, 21.3 feet wide, and has a draft of 9.3 feet. The construction is very heavy throughout. The engine timbers are 25 feet long and 18 inches square, and are securely through bolted to prevent "give" to the ma-

Snapshots along the Seattle waterfront.



1—The Government Ship Canal that joins Puget Sound with Lake Washington. The locks here shown are among the largest in the world.
2—Waterfront scene in the City of Seattle.
3—The "Foss 21," a 76-foot tugboat, converted from steam to Diesel power.
4—The "Martha Foss," sister boat of the "Foss 21." Both of these boats are fitted with 240-hp. oil engines of the PR type.



Some of the fine business streets of Seattle.

chinery and to minimize vibration. A feature of the boat is her fuel capacity of 13,000 gallons—which is a 30 days' supply.

The propulsion engine is the same as that in the *Martha Foss*. It is started and reversed pneumatically; but the deck machinery is operated by a line shaft to the main engine. Air is furnished by an Ingersoll-Rand compressor, which the main engine drives. A 14-hp. Frisco-Standard distillate engine operates a generator and a bilge pump.

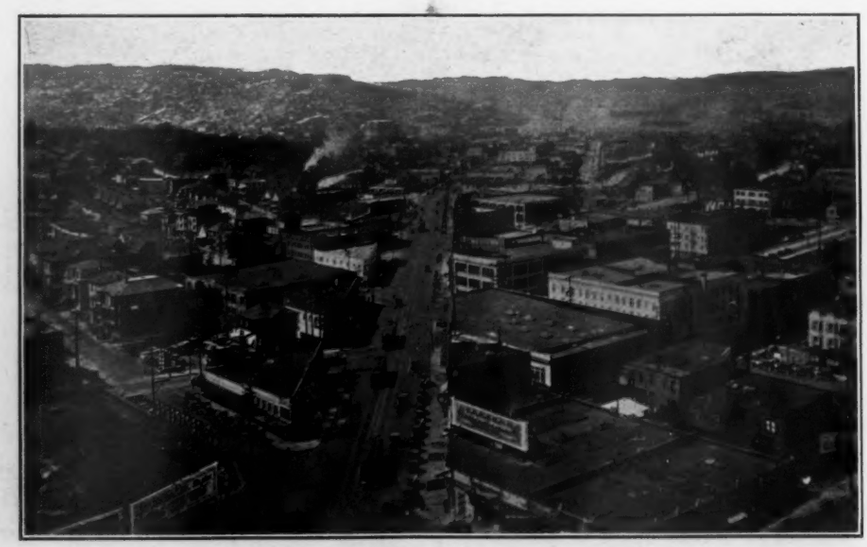
The *Martha Foss* and the *Foss 21* have surprised even their owners by the efficiency and the economy of their operation. Each boat averages from 300 to 400 hours a month in service. The engine on the *Martha Foss* shows a maximum cylinder pressure of only 520 pounds when the boat is tied up at the dock and the shaft is turning 240 revolutions per minute. On a steady tow, the pressure drops to 420 pounds. These figures show the pressures to be very light—a condition that contributes to long life and to trouble-free operation of the engine. This engine uses but 13 gallons of fuel per hour and runs over long periods without the slightest overheating of the bearings.

The *Foss 21* worked steadily for three months towing heavy scows loaded with pulpwood; and at the close of that period a check of the engine revealed that no repairs of any kind were necessary. These scows were 140 feet long, 40 feet wide, and 12 feet deep. The engine was running almost continuously; and the boat did the work which formerly was handled by a 600-hp., triple-expansion steam tug.

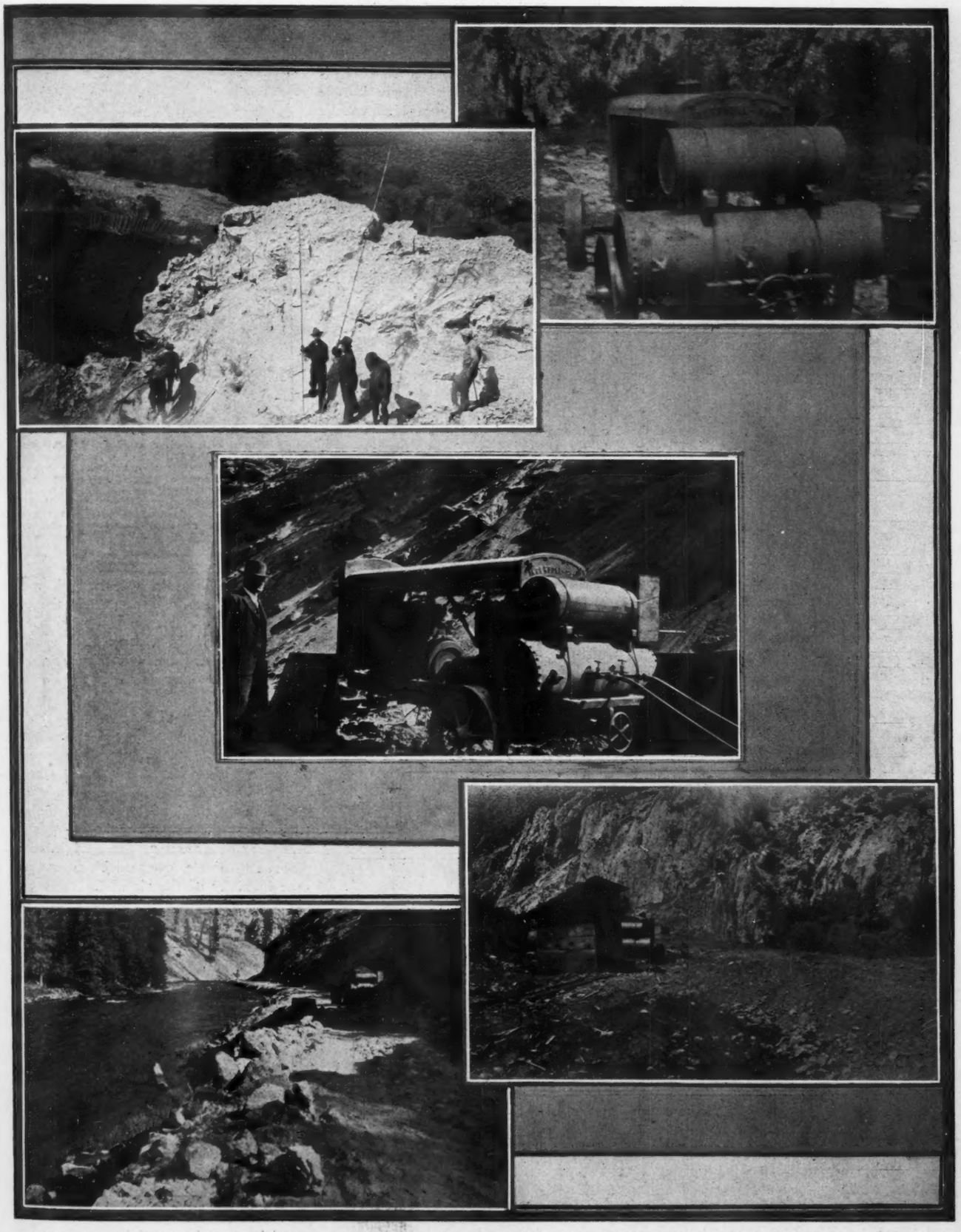
The engines in both these tugs exhibit remarkable flexibility, since they operate with equal ease whether the vessels are making a mile per hour with a heavy tow or running light at 13 miles per hour. On one occasion, the *Martha Foss* towed 34 sections of logs from Tacoma to Seattle, a distance of 25 nautical miles, in 22 hours. The significance of this performance is realized when it is considered that a raft of this size contains 1,250,000 feet of lumber. At another time, the *Martha Foss* conveyed a 1,000-ton scow from Victoria, B. C., to Seattle in 18 hours, maintaining an average speed of 5½ miles per hour.

The story of the Foss Company is intimately identified with the development of the marine industry on Puget Sound. The towing business of the concern started in 1901 with the purchase by Andrew Foss of the H. H. Algar & Sons Launch Company. Between 1901 and 1914, the Foss tugs—numbering from 1 to 10—were gradually acquired as the rapidly developing business of the Northwest brought increased demands for the company's services.

In 1914, the business was incorporated under the name of the Foss Launch & Tug Company. By that time, as a result of the energetic leadership of Andrew Foss, the few original launches had given way to one of the largest and best-equipped fleets on the Pacific Coast. In the years that followed, the growth continued and the fleet extended its services into more and more remote parts of Puget Sound, British Columbia, and Alaska. In 1916, the company bought the Tacoma Tug Company, and in 1920 it absorbed the Rouse Towboat Company of Seattle. By the latter transaction it acquired a fleet of eight tugs. It was at this stage in its progress that the company started upon its program of Dieselization, which is working out so satisfactorily.



Looking toward one of Seattle's inner harbors.



When the Big Hole River, in Montana, was suddenly raised to flood level by the breaking of a dam, the released waters rushed downstream destructively. While on this rampage, the river tore up the tracks of the Oregon Short Line Railroad and threw them up on the opposite bank. In order to furnish a new roadbed for the railway, a beautiful scenic rock, known as Maiden Rock, was drilled and blasted to provide the material for the reconstructed right of way. In this necessary work, in which every effort was made to save time so that the railroad could resume operations, air for the driving of the pneumatic drills was supplied by portable compressors that could be moved quickly to the scene of activities.

UNDERGROUND CABLE FOR HIGHER VOLTAGE

BECAUSE of electrical phenomena peculiar to heavily insulated cables, very decided limitations have been encountered in transmitting high-voltage current through underground and subaqueous lines. These limitations have affected both the economic and the engineering phases of power distribution; and much inventive skill and investigation have been devoted to the development of a practical solution of this problem. These labors have been rewarded, and a degree of success has been attained which gives promise of being well-nigh revolutionary in its beneficial reflexes.

We have in mind a new underground electric cable that has its core filled with oil instead of solid metal; and it is authoritatively stated that a cable of this kind will operate at twice the maximum voltage possible with the usually employed type of underground cable. The following details of the improved conductor have been furnished by the New York Edison Company. The cable, which has aroused keen interest among engineers and cable manufacturers throughout the world, was first installed in the United States during the past summer—12 miles being owned by the New York Edison-United Companies and 6 miles by the Commonwealth Company of Chicago. In the cables now generally in use the copper wires form a solid core surrounded by oil-impregnated paper and enclosed in a lead sheet. The new cable, instead of being solid, has its wires stranded about a copper spiral, making a hollow the entire length of the cable. This central hollow or core is completely filled with oil under constant pressure.

It was only very recently that underground cables could be designed to carry as much as 66,000 volts. The oil-filled cable carries 132,000 volts; and it is expected that cables of similar design will be able to carry as much as 220,000 volts, which is the voltage required for long-distance transmission and system interconnection. In its influence on the trend towards mass production of cheaper electric power through the interlinking of water and steam systems, the new cable has been likened in importance to the introduction of the steam turbine. It is promised that it will make it entirely feasible to transmit electrical energy at high voltage over longer distances than has heretofore been commercially possible. That is to say, current can be produced where physical conditions make it practicable to do so at low cost and then transmitted, with permissible losses, to remote points where the energy can be utilized to advantage and profitably. The new cable will obviate the outlays incident to intermediate substations, with their transformers, switch gear, etc., etc.

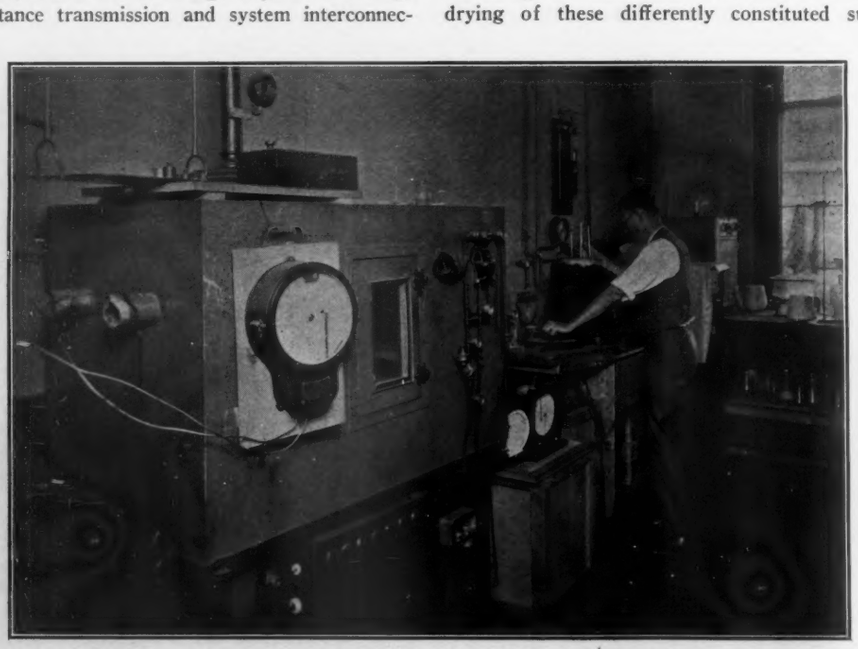
According to Philip Torchio, of the New York Edison Company: "The theory of the oil-filled cable is that through its collapsible oil reservoirs it responds readily to volumetric changes in oil and cable due to temperature changes. In this manner, the whole cable is kept continually filled with oil under pressure both in the hollow core of the conductor and throughout the surrounding insulation. The unique advantage, therefore, of this type of construction is that the spaces thus formed will immediately be filled with oil should the lead sheath be expanded or distorted or the internal elements of the cable be displaced by temperature variations or other causes. In a solid insulation type, on the other hand, voids would be formed, thus causing ionization and ultimate failure."

The air-driven AASE drill here seen is supported by a bracket secured to the ceiling of a tugboat pilot house and serves, through chain drive, to operate the vessel's steering wheel. The action of the pneumatic drill is controlled by a throttle placed conveniently at the after side of the regular hand steering wheel.

SPECIAL CABINET USED FOR HYGROSCOPIC TESTS

THE effect of air on the manifold hygroscopic materials that serve us in one way or another is an important field of research. To help the investigators in this work of determining the conditions best suited to the drying of these differently constituted substances, there has been devised an interesting piece of laboratory apparatus in the form of a small cabinet. Within this cabinet it is possible automatically to control the temperature, the humidity, and the velocity of the air in order to test materials under a wide range of conditions.

The circulation of the air inside the cabinet is effected by blowing into it, through a series of converging nozzles, air at relatively high velocity. These jets of air set up a secondary circulation of about four times the volume of air actually admitted by way of the nozzles. This keeps the air within the chamber in continual and vigorous motion. By means of an atomizing nozzle, operated by compressed air, the humidity of the air in the cabinet can be increased or diminished at will. A glass door in front of the cabinet enables the laboratory man to inspect materials while they are undergoing testing.



Cabinet designed especially for the making of tests to determine the moisture content of various materials or substances.

A contract has recently been let for the construction of what will be, it is claimed, the longest bridge on the African continent. The bridge is to span the Benue River at Makurdi, 290 miles inland from Port Harcourt, Nigeria. The structure is to have thirteen spans, each with a total length between abutments of 2,584 feet. It will take four and a half years to complete the work, which will involve an outlay of approximately $4,750,000.

The route of the proposed trans-Persian railroad has now been definitely determined. According to *Commerce Reports*, work is to be begun at once on the roadbed north from Ahwaz, near the Persian Gulf, and west from Teheran by way of Kazvin to the Caspian Sea.

OPERATING STEAM HAMMERS WITH COMPRESSED AIR

By H. O. TAIR

COMPRESSED air is more and more extensively replacing steam as a means of operating forging hammers. Many such plants are being converted for the use of compressed air, and with resultant savings, which emphasizes again the effectiveness of air as a source of power.

Recent tests in a German locomotive works showed that it was thus possible to bring about a saving of as much as 30 per cent. This was an extreme case, and is not to be considered as regularly obtainable. The average forging plant, however, can be operated on compressed air at a lower total expenditure per minute output than on steam. These savings are often to be found in the somewhat intangible items of stand-by boiler losses, condensation of steam in pipe lines, much reduced hammer and pipe-line upkeep, and an increase in output.

The use of electrically driven compressors, which require power only when air is needed and then only in proportion to the work done, has obviated the necessity of maintaining a continuous supply of steam for the hammers during their shutdown period. Condensation of steam in pipe lines is one of the most serious losses in connection with the employment of steam for forging hammers, not only because of the loss of heat in the steam but also because of the retarding action of the water on the hammer operation and the resulting increased wear on valves and cylinders.

When using compressed air it is essential that a hammer be put in first-class condition with closely fitting piston rings and valves so that there will be as little internal leakage as practicable. If the hammers are once properly equipped in this way it will be an easy matter to keep them in that condition, because they are not subjected to much wear. In fact, by eliminating water from the system, the only possible source of wear in this type of machine is substantially removed.

Further, where air is the operating medium, the cost of pipe-line maintenance is considerably reduced—there being no necessity for traps and moisture separators. Besides, the extremes in temperature to be considered in the case of steam-driven hammers are not encountered when compressed air is the power medium and, as a result, the changes in stress and in position due to these variations in temperature are not as great. This tends to lessen the cost of pipe-line upkeep. Another cost factor is that of insulation, which is essential to steam but not to compressed air.

By preventing the accumulation of water in the system, a much more "snappy" action is imparted to the hammers; and it has been proved over and over again that an air-operated hammer can be expected to give increased output. Packing costs—the principal item being labor—are cut to an almost negligible amount; and in many cases lubrication can be done away with because of the oil which is carried by the air from the compressors. Extra large receiver volume should be provided in any compressed-air installation of this sort for the purpose of storing the air during the time the hammers are idle and to equalize the pressure, as well as to give a much better compressor-load factor. Air reheaters can frequently be used to good effect in saving otherwise waste heat.

Where compressed air is employed to operate forging hammers, working conditions are much improved. There are no hot pipes nor hot hammer cylinders. There is no water dripping on the hot dies. The whole plant is cleaner and more comfortable. And men who have once handled air-driven hammers will seldom consider returning to the type that necessitates the use of steam.

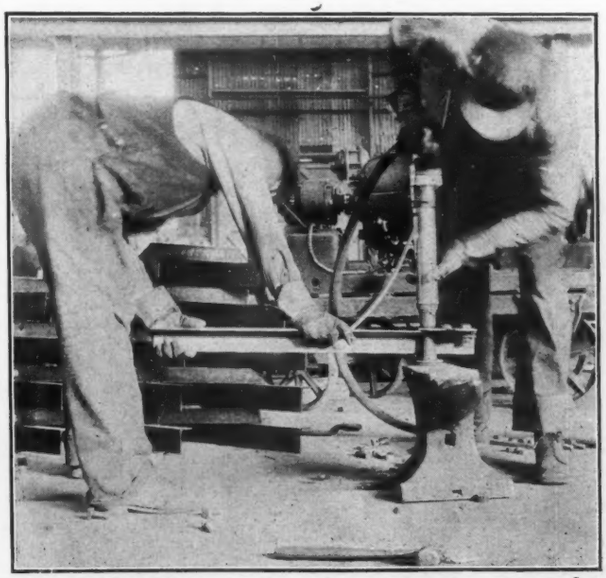
© International Newsreel Photo.
Employees of a New York financial company whiling away twelve hours in a closed vault. They were able to do this without discomfort because the air was purified and revitalized by means of cylinders charged with compressed oxygen. The oxygen was released by special apparatus attached to the flasks. This is a safety provision designed to protect persons confined accidentally in bank and safety vaults between closing and opening hours.

RAPID RIVETING OF PARTS IN REPAIR WORK

STEEL, in many ways, enters into the get-up of modern railway cars not only for the purpose of simplifying their construction but also to give added strength where that is deemed desirable. Accordingly, when cars of this sort are returned to the repair shops for rebuilding or for overhauling, it is frequently necessary to produce in large quantities reinforced light angles, plates, etc.

In work of this kind it is highly desirable that the riveting of the reinforcements should be done quickly and, therefore, easily, so as to save both time and labor. An example of shop resourcefulness, in an effort to meet these requirements, has been given us in a brief article that appeared not long ago in the *Railway Mechanical Engineer*.

In order to facilitate the repetitive operation of riveting reinforcements on light steel materials, a bucker-up in the form of an air-gun tip is made to fit a hole in the top of a heavy anvil, or some similar heavy body of steel. The procedure thereafter is thus explained by our contemporary: "One man holds the light steel on top of the air-gun tip, while the riveter drives the rivets. As the pieces are completed they are stacked in a rack near by from which they may be easily picked up after the job is finished." In this way there is little if any lost motion, and the work goes on at a rapid rate and with but little fatiguing effort to the men concerned.



Courtesy, Railway Mechanical Engineer.
Speeding work in riveting light materials in car-repair shop.

The horsepower unit is said to have been established in a curious way by James Watt—the story being that Watt gathered copious figures to find out the average which the horses of his district could perform. He found that the raising of 22,000 pounds one foot per minute was about an actual horsepower. At that time Watt was employed in the manufacture of engines. Customers were so hard to find that persuasive claims of many kinds were made to induce power users to buy steam engines. For example, as a method of stimulating business, Watt offered to sell engines reckoning 33,000 foot-pounds to a horsepower, or one-half more than the actual. And thus what was intended as a temporary expedient to promote business—a false measure of horsepower—became in time a world-wide unit of mechanical power.—*Russell News.*

Compressed Air Does Record Work In Utah Silver-Lead District

This Operating Agency Has Proved Very Effective Lately In Developmental Work By the Tintic Standard Company

By GAIL MARTIN

WITHOUT compressed air there might, today, be no Tintic Standard Mine. And without the Tintic Standard, Utah's long list of silver, lead, and copper mines—famous the world over for their longevity and richness—would lack one of its greatest bonanzas, a property that in its ten years of productive existence has marketed $50,000,000 of ore and paid stockholders $8,000,000.

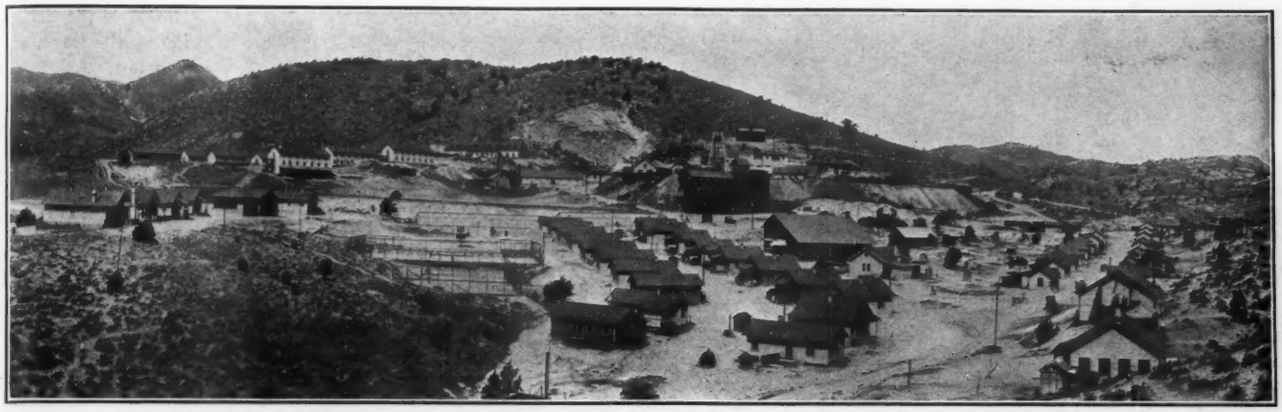
But more than wealth was involved in the Tintic Standard Mining Company's conflict with nature. The discovery of this tremendous silver-lead ore deposit altered the prevailing conception of Utah's already vast mineral resources. The boundaries of the Tintic District—which has been continuously active for over 50 years and has yielded minerals to the value of $294,000,000—were extended almost overnight to include a large domain formerly believed to have no possibilities whatsoever. Moreover, man's power to make his visions come true was strikingly evidenced when victory crowned the attempt of E. J. Raddatz and his backers to develop a mine in the midst of a desolate expanse of sage-covered and juniper-dotted hills, scarred by grim outcrops of limestone and rhyolite.

In this 10-year struggle against obstacles that came within a narrow margin of defying man's courage as well as his mechanical ingenuity, compressed air contributed vitally to success. Compressed air not only furnished the power for drilling, but compressed air aided in combating poisonous gases that more than once imperiled the venture.

No one unfamiliar with gas conditions in the East Tintic District can have an adequate conception of the deadliness of these noxious fumes. On cloudy days, or during the prevalence of south winds when the barometric pressure is low, it is not uncommon for gas to make work impossible in prospect headings even though a strong current of air is pumped down to the miners. Nowadays, operators—knowing the dangers—sink 3-compartment prospect shafts. One compartment is used for a downcast shaft and the other for an upcast shaft, and powerful blowers insure a good circulation of air.

In 1907, when Mr. Raddatz and his backers began sinking the Tintic Standard No. 1 Shaft, nothing was known of the existing conditions. It was supposed that the problems involved would be like those ordinarily encountered in mining operations. A single compartment and manway shaft was started. At a depth of 400 feet, gas issued from the opening in such volumes that for weeks work was impossible. In the face of the present-day knowledge of gas conditions in the East Tintic District, it is almost unbelievable that men could have lived and toiled under the handicaps experienced in sinking that first shaft. But work they did until they reached the 1,550-foot level, where the main ore body was struck and where the gas nearly took the lives of two men.

Looking down from a neighboring hillside upon the Tintic Standard Mine and the Town of Dividend, which it supports.



The Tintic Standard Mine near Eureka, Utah. The first strike of paying ore was made in 1916. Since that time the property has produced $50,000,000 in silver and lead.

It happened that J. M. Snow, a consulting engineer, and his helper were trapped by gas on the 1,550-foot level while doing underground surveying. For hours they were forced to stand with their heads in a narrow pocket of fresh air. A stratum of deadly nitrogen gas lay above them and there was a stratum of carbon dioxide at the bottom of the drift. It was not until enough good air could be pumped down to them that they were able to escape.

In places in the Tintic Standard the rock temperature is burning hot. Timbers have been seared and charred by gas that issues with a hissing sound from crevices or fumaroles. Even after the No. 2 Shaft had been sunk and a connection made with the No. 1 Shaft, ventilation continued to be a vexatious problem. At first, because of the great heat in the mine, the labor turnover was almost 100 per cent. a month. Many of the headings were so warm that even minimum exertion brought on a state of near suffocation.

By installing fans requiring 300 hp. to drive them; by circulating 60,000 cubic feet of air a minute; by mapping every air current in the mine; by putting in electric doors to prevent the gases in the stopes from returning and mixing with the good air instead of proceeding up and out of the upcast shaft, the menace of bad air has been banished. Thus the Tintic Standard has been transformed from the most unhealthful mine in Utah to one of the most healthful; the labor turnover has been reduced from 100 to 20 per cent.; and production has been increased from 1 ton to 1.7 tons a man per diem.

Not long ago, compressed air distinguished itself in the East Tintic District by doing outstanding service in the further development of that region. What is said to be a world record for driving a single-face, mine prospect drift has been won through the utilization of a compressed-air shovel, which also made it possible to discover in a remarkably short period two new producers—thus bringing to a successful culmination a search conducted by a score of companies during the last decade for other East Tintic ore deposits. Ever since the sensational Tintic Standard strike in 1917, prospecting on the east side of the district, save in the Tintic Standard, has gone unrewarded. In 1924, when hope had sunk to a low ebb, the International Smelting Company acquired the North Lily group, and conducted diamond drilling as a check on the geological deductions of its staff.

Actual exploratory work was not begun until September 18, 1926, when the Tintic Standard Company started driving, under contract, a prospect drift from the 700-foot level of its No. 2 Shaft. After that, records held for work of this kind were broken with startling frequency. By January 4, 1927, a picked crew of but fifteen men, working three shifts a day and using a Butler compressed-air shovel, had driven 2,400 feet of 6½x8-foot drift. During the month of maximum progress, an advance of 625 feet was made in 26 working days; the maximum footage drilled in a 7-day week was 205 feet; and the greatest speed attained by the drill runners during any two succeeding days was 65 feet.

Within four months of the day on which prospecting was started for the International Smelting Company, nearly half a mile of drift had been driven; 110 feet of solid lead-silver ore of shipping grade had been pierced in the North Lily group; and 500 tons of ore, averaging from $35 to $40 a ton in silver and lead, had been broken and marketed—this being the outcome of straight development alone. Further, the correctness of an important geological hypothesis was proved; and an amount of exploratory work was done in a few months that would have entailed years of hard and costly toil but for the knowledge gained as a result of the Tintic Standard venture and the aid of modern mechanical means.

The air-operated Butler shovel that was used for loading muck in the North Lily drift.

Nor was this all. In passing through the intervening Eureka Lily group, owned by the Chief Consolidated Mining Company, 40 feet of low-grade ore was struck; and within a month after the North Lily came in as a producer, and hardly a week after prospecting was begun in the Eureka Lily low-grade deposit, another face of high grade was exposed and another shipper added to the list of Tintic District producers.

To appreciate what the record won by the Tintic Standard crew and its mechanical shovel means, a few comparisons are necessary. Taking into consideration all the delays that are likely to arise in mining, a prospecting company that can advance 2,400 feet in a year or a year and a half—as much as was accomplished by the Tintic Standard in three and a half months—has reason to feel gratified. Again it is considered good headway for the average exploration company if it completes in ten months or a year, with one shift a day, a total of 625 feet, or as much as the Tintic Standard men did in 26 days in three shifts. Working by hand, and without the aid of compressed-air drills, the prospector driving 65 feet of heading in six weeks or two months can be satisfied with the progress made. This footage the Tintic Standard crew "rolled up" in two days. While railroad tunnels have been driven greater distances in the same length of time, the record to the credit of the Tintic Standard Company's picked gang has not, so it is believed, been excelled by others doing the same class of work.

It is the unanimous opinion that this unusual progress is chiefly attributable to the efficiency of the compressed-air shovel. Under ordinary circumstances, the problem is to keep the muck out of the way of the drillers who, with their powerful air-operated machines, can break more ground in a given period than can

be removed by the limited number of men that can work at the face of a prospect drift. With the Butler shovel, the type used, conditions were reversed: difficulty was experienced in breaking enough rock to keep the shovel busy. Whenever the footage dropped, it was not, according to Tintic Standard officials, the fault of the shovel but, instead, due to the inability of the drillers to keep ahead of it. It was found that this indefatigable air-driven machine could load in a 6.5 x8-foot drift an average of 20 cars of 18½-cubic-foot capacity, or 23 tons of rock, in an hour. That is, two men—a shovel operator and a trammer—were able to load as much rock as it would have been possible for sixteen men to handle if that number could have worked in the confined space available in the prospect drift.

This drilling crew set a new world record in driving a single-face prospect drift. At the right end of the front row is George Hezzlewood, shift boss and designer of a portable switch that aided materially in making the record possible.

The shovel, so it was proved, could dig 8 inches below the rails. It could load muck into cars 48 inches or more high, leaving the sides and corners of the drift clean. If a larger heading is desired the same shovel can be employed, because its wide clean-up of 18½ feet makes it suitable for service in bigger tunnels and stopes. Cars can be loaded at either side or the rear, as may be desired. In other words, this type of shovel is adaptable for use in either single- or double-track tunnels. Eighteen-inch-gage track and 12-pound rails were utilized.

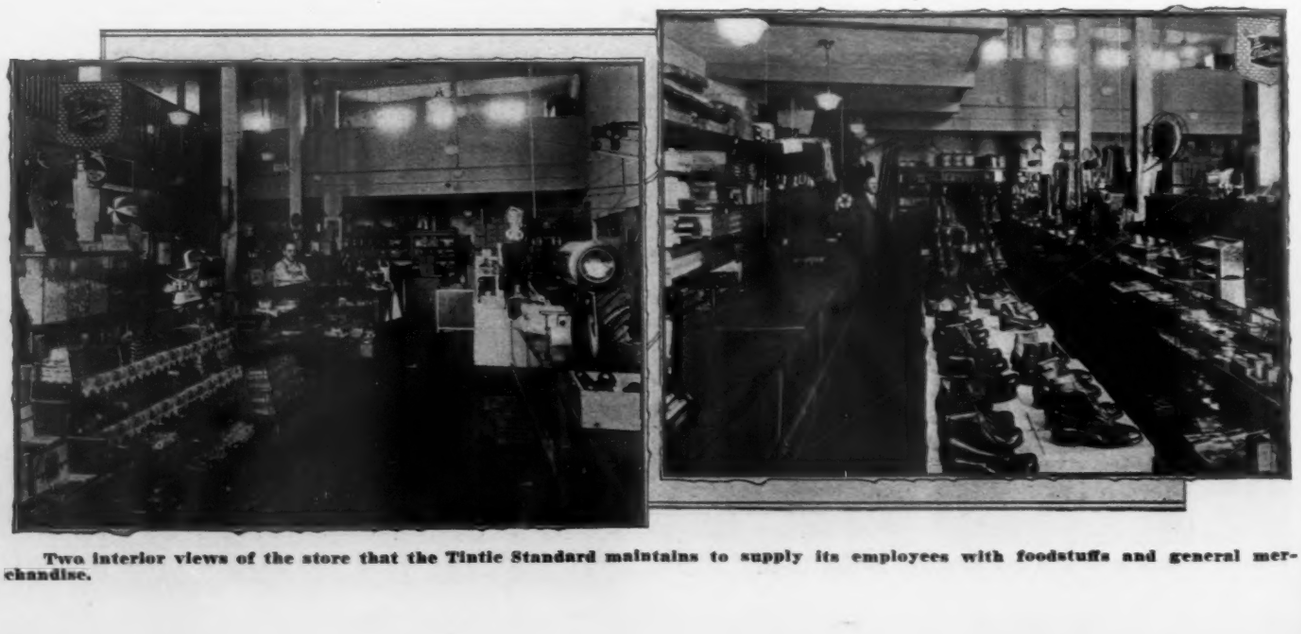
The air consumption is low—not more than 135 cubic feet of air per minute, at 70 to 90 pounds pressure, being required to operate the shovel. This economy in the use of air is made possible by the manner in which the air is employed and by the proportioning of the various parts of the machine. The pressure exerted by the air acts upon a single-thrust cylinder, and this direct thrust not only gives a better leaverage to the power movement but also brings about a material reduction in air consumption. The ¼-yard dipper, which is so constructed that the severe strains resulting from the digging action are borne by the dipper rather than by the arms, has a speed of three and a half passes a minute, or a shovel capacity varying from 15 to 30 tons an hour.

One of the features that contributed largely to speed of operations was a new type of moveable switch, designed by Shift Boss George Hezzlewood, large enough to accommodate ten cars. This siding is made to fit over the permanent tunnel track; and, in the case in question, permitted the handling of cars without widening the drift, tearing up the track, and setting ties.

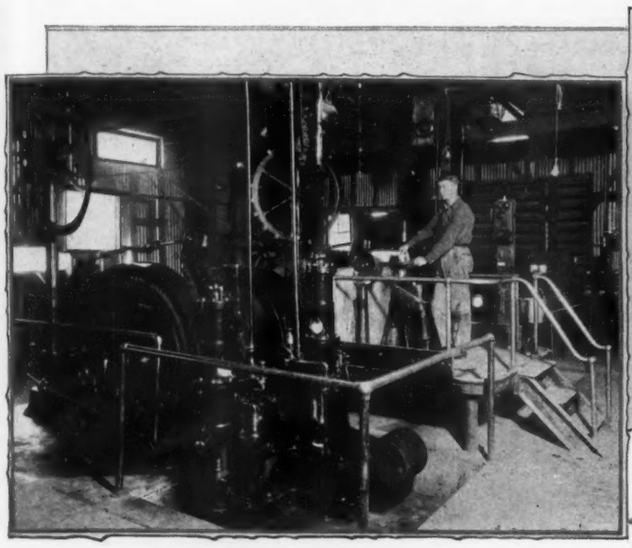
The Hezzlewood switch consists of a double-track unit, 40 feet long, with two equilateral turnouts at each end. Iron spreaders, instead of ties, are used to space the rails on the switch; and no clamps or spikes are required to fasten the switch to the track. The turnouts are spaced to give cars 3 inches of clearance. This siding was kept about 150 feet back of the face so that enough cars could always be kept in readiness within short tramming distance. Inclined rails were provided so that the cars would have no difficulty in mounting the difference in elevation between the permanent rails and the switch, which amounted to 2½ inches. Two trucks were needed to shift the switch from point to point.

In driving the North Lily drift, the type of drills utilized, the average depth of round, and the number of holes drilled depended on the nature of the rock. In hard ground, wet drifters, mounted on a crossbar, were used; and for this work the Ingersoll-Rand R-72 drill was found most satisfactory. The average 6½-foot round consisted of fourteen holes; and it took anywhere from two and one-half to three hours to do the necessary setting up and drilling per round. In soft ground, unmounted "Jackhamers" served to drill the average 6½-foot round of twelve holes in from three-quarters of an hour to one and one-half hours.

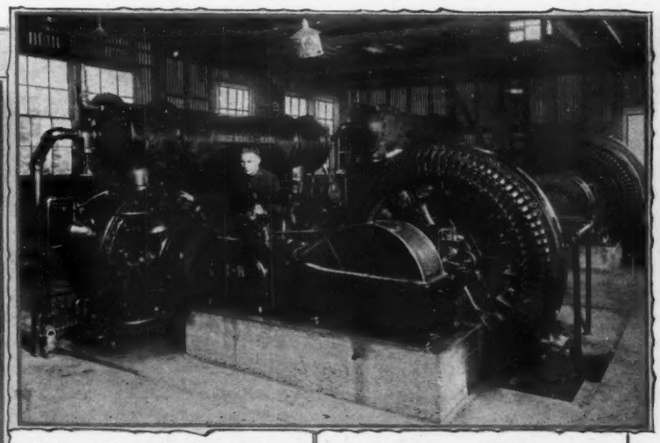
Ventilation was effected by a motor-driven fan that forced fresh air through a 16-inch



Two interior views of the store that the Tintic Standard maintains to supply its employees with foodstuffs and general merchandise.



Left — Electrically driven main hoist installed at the Tintic Standard Mine.



Right—Two PRE-2 compressors that supply the operating air used in the mine.

galvanized-metal conduit 4,000 feet long. Two pneumatic fans in the line acted as boosters. This ventilating system was so effective that drilling at the face could be resumed 30 minutes after blasting. The shovel crew, consisting of an operator and a trammer, not only attended to the shovel but also laid the track and piping, and trammed all cars to and from the shovel. Each shift was made up of two miners, one shovel operator, one trammer, and one mule skinner. The average operating cycle was as follows:

Oiling shovel, barring down, and preparing to drill.....	30 to 45 min.
Drilling and mucking up to the miners	90 to 120 "
Laying track, pipe, and ventilating line	60 "
Loading and blasting.....	30 "
Waiting for heading to clear..	30 "
Average time to complete cycle	285 "

The compressed air for this exploratory work as well as for other Tintic Standard activities was supplied by two Ingersoll-Rand PRE motor-driven, 2-stage, direct-connected units, which furnished approximately 4,100 cubic feet of air per minute.

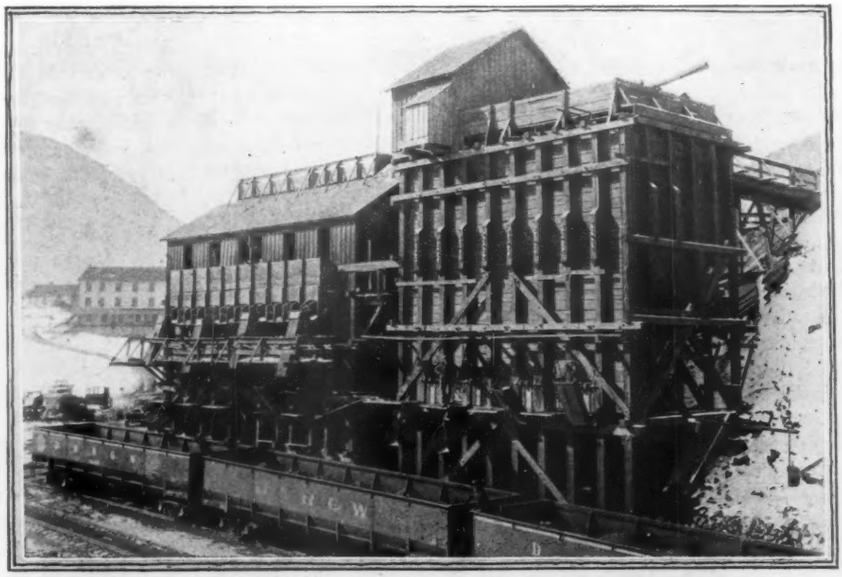
The production of an oil that will kill any known germ is the claim made by J. B. Jenson, a Salt Lake City mining engineer. The germicidal oil is the product of coal and other hydrocarbons, and was discovered by Mr. Jenson while engaged in researches looking toward the development of smokeless fuel.

NEW ZEALAND INCREASES USE OF WATER POWER

THE harnessing of water power in New Zealand is proceeding rapidly, according to *Commerce Reports*. Second only to the Arapuni scheme in point of capacity is that of Waikaremoana, with which the Public Works Department has made good progress during the past year. At present about 400 men are employed on the project, which is scheduled for completion by June, 1929.

While the chief characteristic of the Arapuni scheme is a large dam, that of Waikaremoana is pipe lines—Nature already having created the dam. Landslides in the distant past and on a vast scale blocked a gorge so as to imprison water having a superficial area of more than 20 square miles. This reservoir has a maximum depth of 850 feet, and its surface level is at an altitude of 2,015 feet.

Two miles downstream, the valley bottom lies at an altitude of 615 feet; and this drop of 1,400 feet below the lake level lends itself especially well to the building of hydro-electric stations. In other words, the slope of this Nature-made dam is such that it will be practicable to construct three generating stations, at different elevations, that can successively make use of the power in the descending waters.



Bins from which ore is loaded into cars for shipment.

SPHAGNUM MOSS EFFECTIVE INSULATING MATERIAL

SPHAGNUM moss, as most of us can recall, was widely utilized during the World War as a dressing for wounds. Now we learn that it is an excellent insulating material in housebuilding, and in that capacity is gaining favor in Sweden, especially in the construction of suburban homes.

It has been found that the ancient Scandinavians recognized the value of sphagnum as an insulating and a calking material, as they employed it for that purpose in their castles, forts, churches, and other structures. With this in mind, an enterprising company has turned its attention to the vast sphagnum bogs of Sweden, with the result that the moss from those erstwhile more or less unprofitable lands is today being put to commercial use in the form of an insulating matting. This matting consists of layers of the moss fibers stitched between two sheets of kraft paper. It is said that building experts have endorsed the new material, which is particularly desirable in connection with timber structures because it contains a large percentage of tannic acid, a wood preservative.

DIVISION ON AIR MACHINERY PROPOSED FOR SOCIETY

THE following open letter in a recent issue of *A. S. M. E. News*, the organ of The American Society of Mechanical Engineers, should be of interest to our readers, as it is added evidence of the growing importance of compressed air in the manifold departments of industry.

"To the Membership:

In order to stimulate interest in the subject, to keep abreast of current developments and research, and to provide a forum for discussion of its problems, it has been recently suggested, and long considered desirable and necessary to provide for the formation of a new professional division in the Society, which may be designated as the Division on Air Machinery. It is the object of this letter to present this idea to the interested membership, and to have their comment and reaction thereto.

Quite a wide scope would be covered by such a division and one which should prove of interest and service to a large percentage of the Society's membership, as well as to practically all branches of the engineering profession. It will be pertinent to outline briefly the proposed and suggested scope of such a division, which, incidentally, is not intended to overlap that on aeronautics, in itself a highly specialized subject.

(1) Compressed-air plant and equipment:
  (a) Compressor plants
  (b) Turbo-compressors
  (c) Positive-pressure blowers
  (d) Air lifts and pumps
  (e) Air motors and hoists
  (f) Air hammers and drills
  (g) Blowing engines
  (h) Auxiliary and control apparatus.

(2) Compressed-air transmission.

(3) Air motive equipment and applications:
  (a) Power subdivision: forced- and induced-draft fans.
  (b) Architecture and building subdivision: ventilation, heating, and air conditioning for buildings.
  (c) Industrial subdivision: mine and industrial ventilation, industrial heating, and drying.
    (1) Types and characteristics of units.
    (2) Main ventilating systems for mines.
    (3) Auxiliary ventilating systems for mines.
    (4) Industrial ventilating, heating, and drying.

(4) Relation of ventilation and air conditioning to production, labor turnover, safety, physiological consideration.

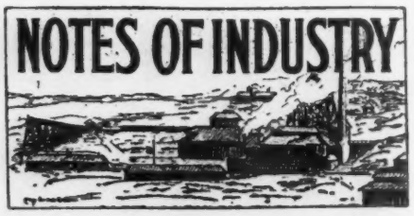
(5) New developments and applications in air motive equipment.

(6) Machinery using gases similar to air.

(7) Extra high-pressure air machinery.

This outline of the scope of the proposed division is in the nature of a rough draft, and your opinions and criticism are solicited, with any suggestions which may arise in this connection.

Very truly yours,
P. W. BELCHER."



At a recent meeting of the French Academy of Science, according to *The Engineer*, M. James Besset read a paper describing an apparatus of his own invention by which it is possible to study chemical reactions under a pressure of 20,000 atmospheres. The special purpose of the device is to enable laboratory men to investigate the allotropic modifications of carbon.

The Western Road and Equipment Exposition is to be held this year at Los Angeles, Calif., from March 7 to 11, inclusive. A 40-acre tract in the central manufacturing district of that city has been made available for the show; and visitors will be given an opportunity not only to view the latest products —including heavy-duty machinery—but also to see competitive equipment in action under service conditions.

An elaborate scheme has been proposed by the Paris Municipal Council to conserve energy by providing the French capital with hot water for heating, etc., all the year round. The plan is to begin this service in the eastern districts, where there is a large abandoned power station on the Quai de la Rapée that could readily be converted for that purpose. New plants are to be added as funds become available, until every quarter of Paris is linked up in this system of central heating.

Of the 27,783,963 telephones throughout the world at the beginning of 1926, almost 61 per cent., or 16,935,918 were in the United States.

What may prove to be one of the largest deposits of a precious variety of beryl is reported to have been discovered in the Transvaal.

Whether or not Trinidad's famous asphalt lake is inexhaustible, it is a fact that the level has not receded more than around 15 feet during the 40 years in which it has been producing regularly many thousands of tons annually. The surface of the lake covers an area of about 100 acres; and the present yearly output exceeds 100,000 tons.

The men of the United Verde Extension Mines seem to be bent on trying to outdo themselves. Not long ago they made a record in shaft sinking; and now *The Northern Miner* reports that Manager A. J. Anderson and his husky crew of hard-rock miners drove more than 500 feet of drift in a month on property adjoining the Noranda. The work was advanced from two headings; and two R-72 "Leyner" drifters were used in breaking through the ground.

Except for Prince Edward Island, gold has been found in every province of Canada.

Because of the great local demand for coffee sacks, Sao Paulo, Brazil, is fast becoming a jute-manufacturing center, even though the necessary raw materials have to be imported.

Geologists have estimated that the salt mines at Malagash, Nova Scotia, contain at least 60,000,000 tons of 99 per cent. pure salt, or enough to warrant working the property for the next 450 years.

It is reported from abroad that a subsidiary of the French Nitrogen Company L'Azote Français has formulated plans to make use of tidal power under a patent that has been tested by the Commission of Blue Coal, or Tidal Power Commission, attached to the French Ministry of Public Works.

The new Maas-Waal Canal, opened to traffic late in 1927, shortens the line of communication between Limburg and northern Holland by 50 miles. The waterway is about 8 miles long, 13 feet deep, and has a width at the surface of 162 feet and at the bottom of 108 feet. This canal is part of a scheme planned several years ago by the Netherlands Government to make the River Maas the principal artery in a system of waterways designed to connect the important centers of Holland.

Plans have been drawn up for the building of a tunnel under the River Seine to provide better means of communication between Havre and Honfleur, which are now inadequately served by small ferries. The proposal, which has been submitted to the French Minister of Public Works, calls for a tunnel a quarter of a mile long and having a roadway 20 feet wide. It is estimated that the work could be finished within three years.

According to recent progress reports, the Hume Dam, building in Australia, is to be completed in 1930 and somewhat earlier than scheduled. This dam, which will be one of the largest in the world, is to impound the waters of the Murray River. The large hydro-electric plant to be erected on the dam site will make power available throughout a radius of 150 miles from that station.

Work on a large irrigation project has been begun by the Peruvian Government in an attempt to stimulate the cultivation of cotton and sugar. A total of 130,000 acres of arid lands are to be irrigated by the waters of the Rio Huancabamba, which are to be diverted by way of a tunnel to several reservoirs. The tunnel is to be driven through the Andean Cordillera range, and will have a length of seven miles.

Four new steamship berths and a grain elevator of 2,000,000 bushels capacity are to be constructed at the Port of St. John, New Brunswick.

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EDITORIALS

ENGLISH CHANNEL TUNNEL PROJECT REVIVED

JUST once so often new life is breathed into the English Channel project, first conceived decades ago and actually advanced far enough to demonstrate that the work could be carried out, thanks to mechanical facilities devised for the purpose of cutting a passageway in the chalky formation underlying the channel. It is a matter of common knowledge that certain military authorities became alarmed, and succeeded in bringing about a dominating public state of mind against the completion of the undertaking. England's isolation was considered indispensable to national defense; and a subaqueous tunnel was pictured as a likely means of promoting the landing of hostile forces.

Be this as it may, conditions in the English Channel become occasionally such as to effectually prevent intercourse by water between England and the Continent for a period of several days. The economic consequences of this grow more serious with the passing years; and it is not surprising to learn that another move is on foot looking to the resumption of work on this long-considered and intermittently revived scheme.

It now seems that certain British monetary interests, aware of the success of the Holland Vehicular Tunnel under the Hudson River, believe that that underwater highway proves the practicability of a tunnel to extend beneath the English Channel from Dover to Calais. One of the principal problems to be solved in a tunnel about twenty miles long would be that having to do with proper ventilation; and even if a method similar to that adopted in the Holland Tunnel were utilized, ventilating shafts placed at the water's edge on the English and the French sides of the channel would not be able to provide fresh air for the intervening stretch of tunnel.

To overcome this difficulty, so it is reported, artificial islands would have to be reared at different points along the line of the tunnel, and at each of these islands ventilating blowers would have to be installed to force fresh air into the underlying trafficway and to withdraw the vitiated atmosphere. Theoretically, this is perfectly sound as an engineering proposal; but we cannot help but wonder how strategists, both naval and military, would look upon such arrangements. Unless we err greatly, the consummation of a tunnel under the English Channel is a thing that will still be delayed for a long while.

PANAMA CANAL PAYING HANDSOMELY

DESPITE the skepticism of many people in the years gone, the Panama Canal has amply justified itself from a military standpoint and also from the angle of a worthwhile commercial venture. Since the canal was opened for navigation in August of 1914, there has been a steady growth in the traffic of ships of trade using this man-made waterway; and the tolls have increased from $4,367,550 in 1915 to $26,231,023 collected on tonnage utilizing the canal during the fiscal year ending June 30, 1927. In short, the canal, today, is returning to the United States Government a substantial annual profit after deducting operating costs and interests on the investment.

Probably the most significant aspect of this revenue-making traffic is the large percentage of the business represented by ships engaged in the transportation of petroleum. When the canal was opened to the shipping of the world, no one realized the potential volume of this particular traffic; and its fairly amazing expansion is, of course, due to the greatly stimulated demand for petroleum and its derivatives—a demand that has brought about a world-wide search for oil and an enormous development of the industry as a whole.

With a normal growth of overseas trade, in which the Panama Canal will share, and the probable continued swelling of the volume of oil that will be moved through the canal, we are likely to be confronted before long with congestion in this water route; and it is inevitable that relief will have to be sought. This relief can be obtained in two ways: by enlarging and by multiplying the existing facilities of the Panama Canal or by building an entirely new waterway—possibly across Nicaragua.

We can all recall the reasons broadly advanced in preference for the Panama route and, conversely, the grounds on which the Nicaragua route was opposed. In the last analysis, most of the opposition to the Nicaragua route was that the projected canal would have to pass through a section of Central America in which earthquakes have occurred from time to time. Records are available, covering the intervening period, that will serve either to confirm or to disprove the validity of this objection.

Unless there are physical difficulties of insuperable proportions and the likelihood of seismic disturbances of a grave order, it would appear desirable to build a canal across Nicaragua provided the outlay would not be much greater than that entailed in amplifying the Panama Canal sufficiently to take care of future estimated traffic. From a purely military point of view, this would seem the part of wisdom, because we should then not be placing entire dependence on a single waterway to link the east and the west coasts of the United States in an hour of national peril.

GREENLAND'S ICE CAP PLAYS DUAL ROLE

"GREENLAND'S icy mountains" is something more than a poetic figure of speech wherewith to contrast the coral strand of India: it is a twofold source of menace to the navigator threading his way over the steamship lanes of the North Atlantic. Only half of this was realized to be true until within the past year or two.

It has long been known that Greenland's ice cap launches annually into neighboring Davis Strait fragments of slowly moving glaciers, and these icebergs drift southward into the Atlantic where they jeopardize the safety of ocean-going craft for a period of several months during spring and summer. It is because of these grim intruders in the warm waters of the Atlantic that a special ice patrol is maintained yearly to warn ships of the existence and the positions of icebergs and to do what it can to blast them and to hasten their disappearance.

Now we are told by no less an authority than Prof. WILLIAM H. HOBBS, of Michigan University, that Greenland's ice cap is likewise the birthplace of many of the violent storms that sweep the North Atlantic from time to time. As he pointed out recently in the *New York Times*, this fact has been well established by observations made at a temporary meteorological station in Greenland. It has been found that these storms can be observed in the course of their development two days before these atmospheric disturbances reach the traveled waters of the North Atlantic.

As Professor HOBBS has explained: "In both summer and winter, the north pole of cold lies in the interior of Greenland, where also is located the north pole of the winds. Here are born our northern storms which sweep out over the Atlantic steamship lanes and the future routes of airplanes and dirigibles between America and Europe." Manifestly, a permanent meteorological station in Greenland is a thing to be desired. With two days' notice of an impending storm, craft can follow a more southerly course and take what other precautions may be necessary to safeguard them on their transatlantic runs.

COMFORTING STATISTICS

THE average American is not only living longer but he has every chance to be wiser than his forebears of a generation back. How well he lives, and how much he learns from the many sources of human knowledge available to him in the added years that are his, naturally depend upon his own conduct and the way in which he directs his mental activities.

According to a recent pronouncement by Dr. IRVING FISHER, the average American, by 1999, should live to be eighty years old—thus exceeding by a decade the Biblical longevity of three score and ten. Inferentially, this means that the vital carry-over from year to year will be larger because mortality will drop more or less proportionally as length of life increases. Septuagenarians will have ten years more at their disposal in which to swap stories and to tell how things were done when they were young; and the youth of the same period will probably whoop up things more energetically in the days of their utmost vigor, bearing in mind that they will be a long time old. Professor FISHER sets no definite date when the average American may be expected to live to be a hundred years old.

The foregoing announcement was made public just about the time that another prophet, Dr. O. E. BAKER, of the United States Department of Agriculture, predicted that the nation would, in the main, be able to provide food enough for itself for the next three-quarters of a century. That is to say, food production in America would, for the next seventy-five years, keep pace with our increasing population. This assurance of enough to eat, per capita, until the year 2,000 is contingent upon our farmers making the most of the scientific knowledge garnered in experiment stations and otherwise manifesting a responsive spirit to progress generally.

To the person who still believes America is a favored land, and that life in it is worth living, Doctor FISHER'S promise of longevity will be welcome; and to the man who does not have to worry about his next meal, what Doctor BAKER says about our future food supply will justify him in demanding everything from soup to nuts. What the other fellow will think about these vital statistics will depend largely upon his present circumstances—many of his kind will have more pressing matters to engage their attention.

A new form of transport in regions of ice and snow has been conceived by a Russian engineer. He proposes using oil-engine tractors to tow loaded sledges over frozen waterways. The tractor is to be mounted on sledge runners, and is to get its grip on light, flexible rails laid on the ice. These rails, in 2.5-mile lengths, are to be anchored only at the end; so that they can be easily lifted and rolled up when the ice breaks up. Trainloads of 125 tons are suggested.

A group of Greek capitalists is proposing to erect a large sugar refinery near Saloniki.

ROTARY CONVERTERS, by E. P. Hill. An illustrated volume of 329 pages, published by the D. Van Nostrand Company, Inc., New York City. Price, $9.00.

THIS book deals with the principles and operating characteristics of the rotary converter, and has been written from an operation and commercial point of view. However, considerable material has been included of an instructional character that will render the volume of value to engineering students. The author has endeavored to produce a work that, primarily, will be an aid to engineers responsible for the purchase, the operating, and the testing of rotary-converter machines.

A DICTIONARY OF MODERN ENGLISH USAGE, by H. W. Fowler. A book of 742 pages, published by the Oxford University Press, New York City. Price, $3.00.

THIS book is not a dictionary of the ordinary type; and, strictly speaking, it is not intended to take the place of a dictionary but to supplement such a work. It is designed primarily to help any one that wants to speak or to write English forcefully, clearly, and gracefully. In other words, the volume deals with practical problems in grammar; is an effective book of synonyms; and, besides discussing correct speech and pronunciation, has also to do with punctuation. The work should be on the shelf or the desk of every person whose business it is to write, or to deal by word of mouth with a considerable audience.

APPLIED MAGNETISM, by T. F. Wall, head of the electrical engineering department, University of Sheffield. An illustrated volume of 262 pages, published by the D. Van Nostrand Company, Inc., New York City. Price, $8.00.

MAGNETISM is the twin sister of electricity, and, as far as record goes, it was put to practical service by man for his guidance ashore and afloat long before electricity served him in any useful way. Even so, applied magnetism is in its infancy today, while electricity certainly enjoys a robust adolescence.

Our knowledge of magnetism has gone forward steadily in recent years; and because of the wide and increasing industrial importance of magnetism the author has endeavored to produce a book of moderate size that would give a reasonably complete survey of this branch of electrical engineering. We believe he has succeeded admirably in his undertaking.

ANNUAL SURVEY OF AMERICAN CHEMISTRY, edited by Clarence J. West. A book of 415 pages, published for the National Research Council by The Chemical Catalog Company, Inc., New York City. Price, $3.00.

THIS is the second volume of the Survey, and covers the period between July 1, 1926, and July 1, 1927. The topics dealt with include gases and gas mixtures, colloid chemistry, catalysis, heavy acids, aluminum, water and sewage, glass, rayon, leather, etc. The different subjects are presented authoritatively and, for the most part, in a notably lucid and absorbing manner. The book is a striking record of America's progress in chemistry during the period covered.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR 1926. A profusely illustrated volume of 551 pages, published by the United States Government Printing Office, Washington, D. C. Price, $1.75.

IN addition to outlining the activities of the institution during the twelvemonth concerned, the report contains a general appendix in which are reproduced papers touching upon many fields of science and research. For the most part, the subjects treated are handled in a way to appeal to the average reader, and thus they serve to broadcast a vast fund of valuable information. Many of the topics, indeed, are of a fascinating nature; and we know of no work of a kindred character that we can more strongly commend to the public at large.

MINING ENGINEERS' HANDBOOK, by Robert Peele, Editor-in-Chief. An illustrated work of 2,523 pages, published by John Wiley & Sons, Inc., New York City. Price, $10 for a single-volume edition.

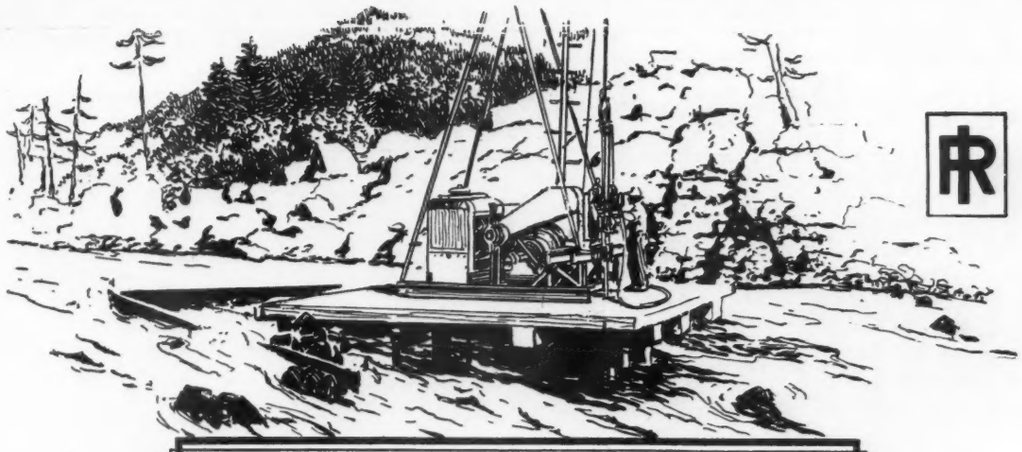
THE present work is the second edition of this admirable handbook which first appeared ten years ago. The broad recognition won for the book during the past decade is the best evidence of its usefulness and its worth. The exhaustive manner in which most of the topics considered are presented makes the volume especially valuable to the practical engineer. As in the earlier edition, the section having to do with compressed-air practice is competently handled, and we feel sure that the data contained therein will prove extremely helpful to anyone utilizing compressed air and a wide variety of air-operated equipment.

HANDBOOK ON GAS LIFT IN BLOWING OIL WELLS

A VALUABLE contribution to the literature on the gas lift in the field of oil production has lately appeared in the form of a handbook bearing the title, *Oil Well Blowing Handbook*. It has been published by the Ingersoll-Rand Company, well-known manufacturers of compressors, 11 Broadway, New York City, and is a compilation of articles by S. F. Shaw, A. F. Hinton, D. B. Dow, and L. P. Calkins, all recognized authorities on the subject.

The handbook covers such topic matter as the principles of air and gas lifts; the solubility and effects of natural gas and air in crude oil; and the installation and care of compressors in oil fields. Besides it contains tables that will help the operator in figuring tubing submergences.

As the name implies, the book is of pocket size. It has a flexible binding, and is well illustrated. Oil producers desiring copies of this work can obtain them free of charge upon application to the Ingersoll-Rand Company.



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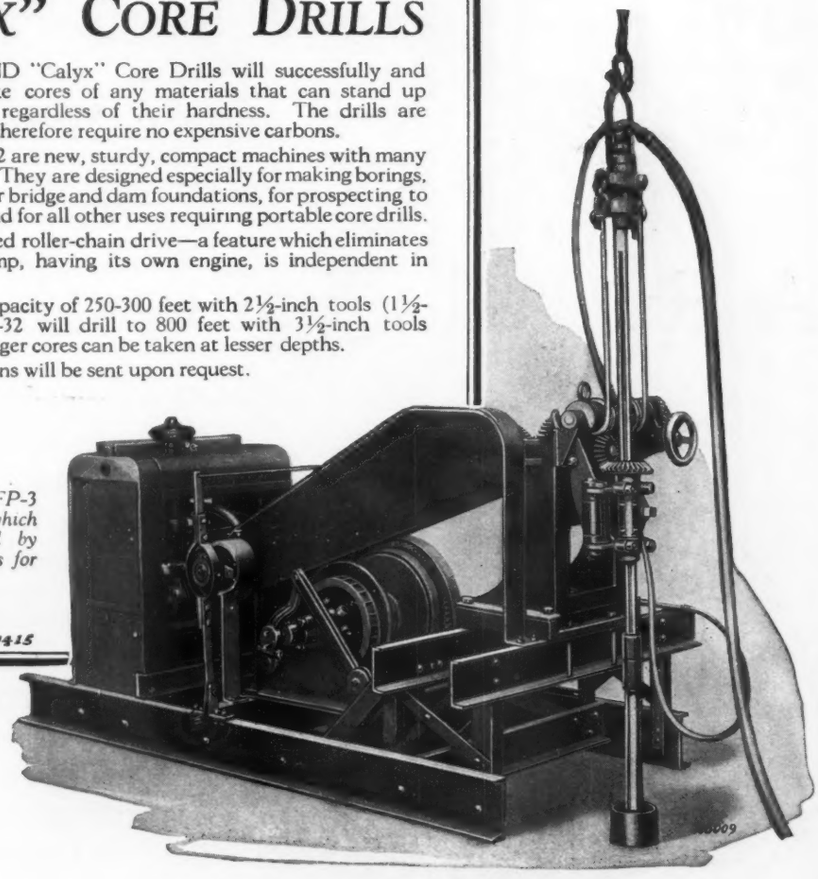

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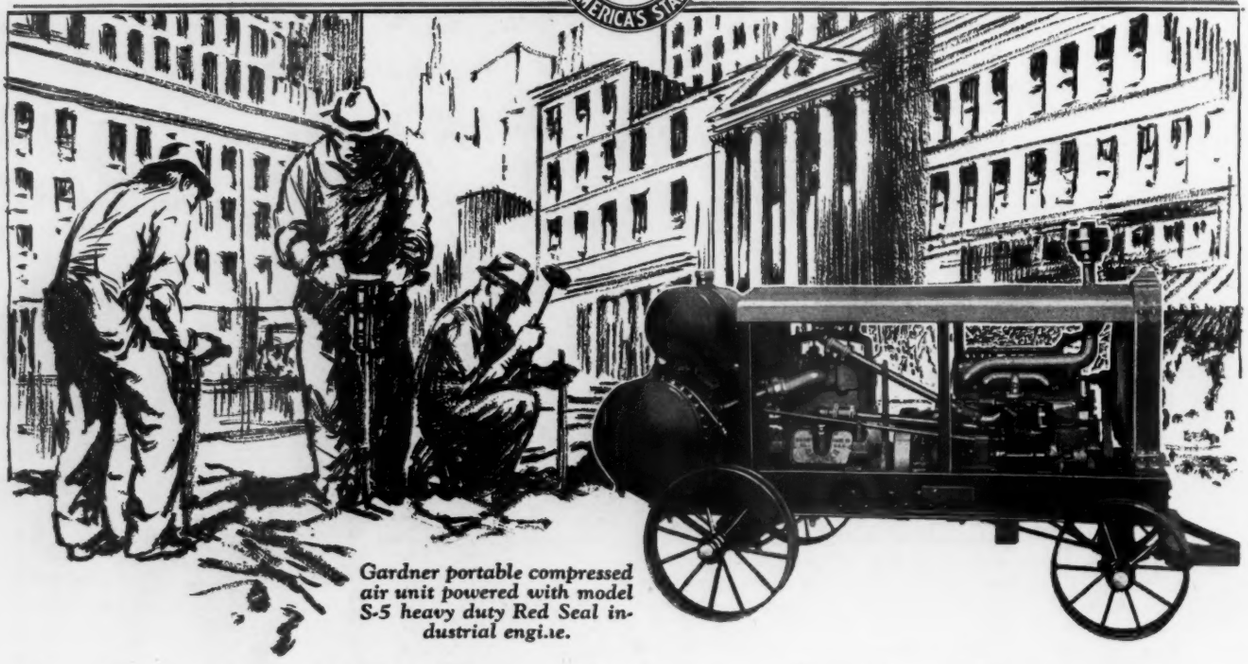

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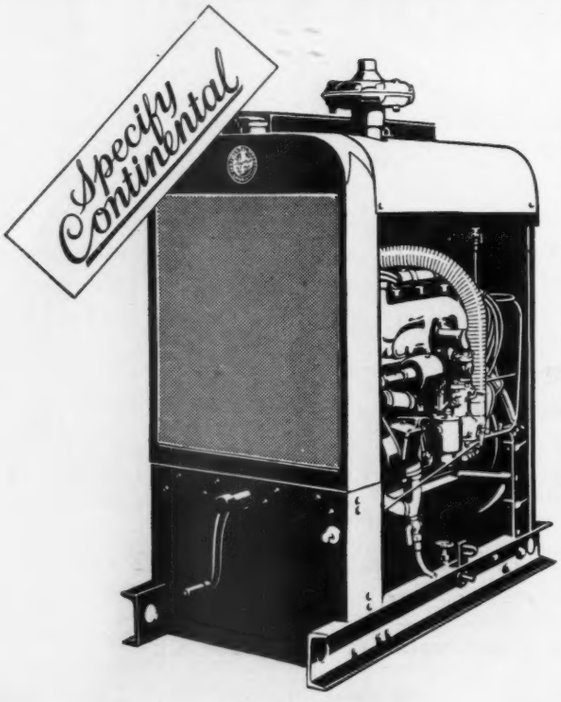

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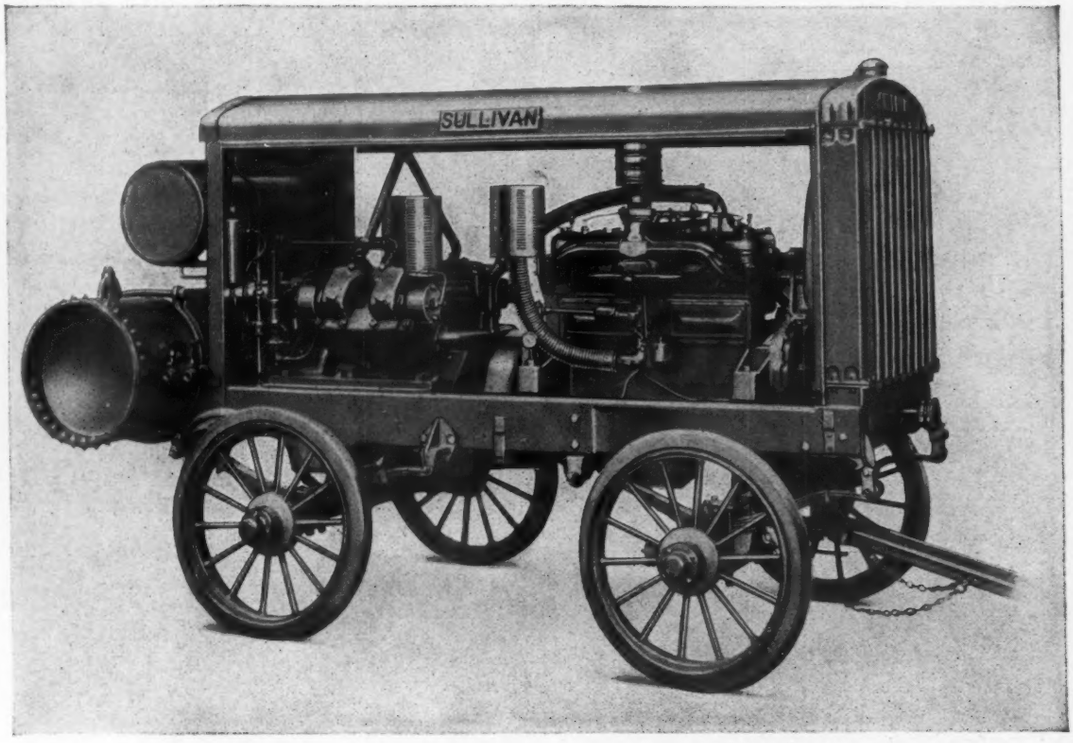

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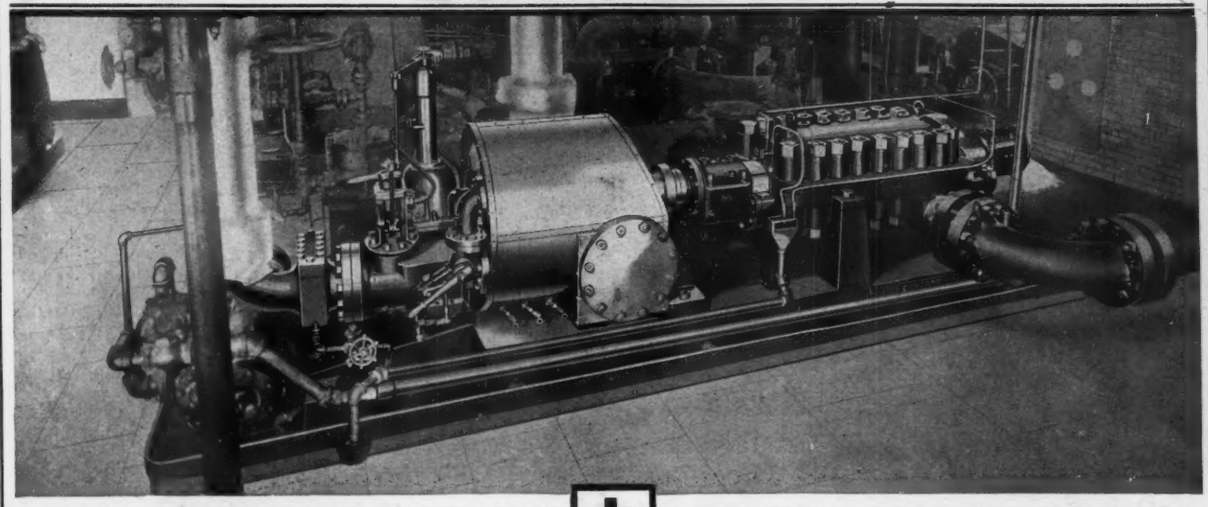

TO provide against possible interruptions in the service of the main feed pumps, the Edgar Station of the Edison Electric Illuminating Company of Boston (Irving E. Moultrop, Chief Engineer; Stone & Webster, Inc., Builders) has installed a Cameron Class "HT" six-stage machine with a capacity of 1900 gallons against 1600 lbs. pressure at 3,600 revolutions.

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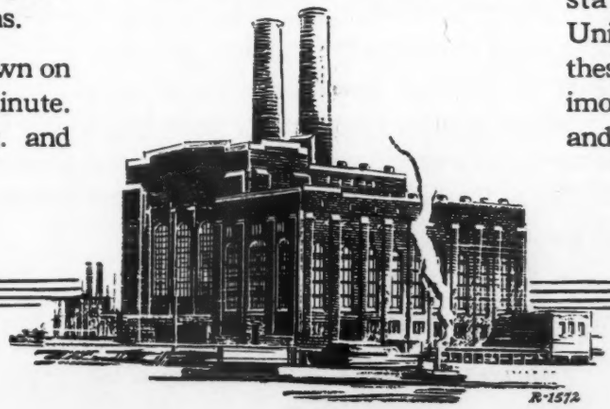

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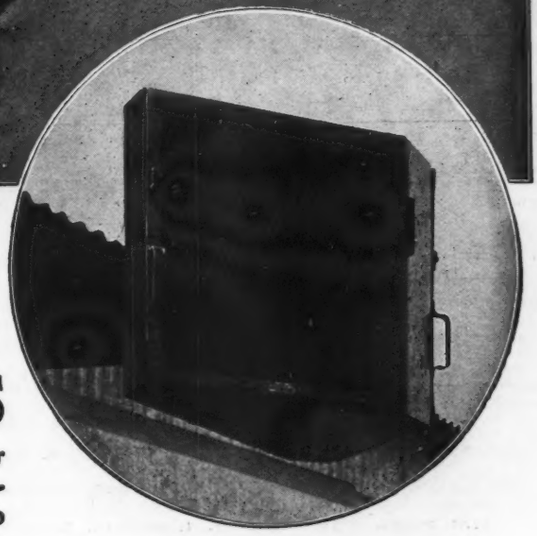

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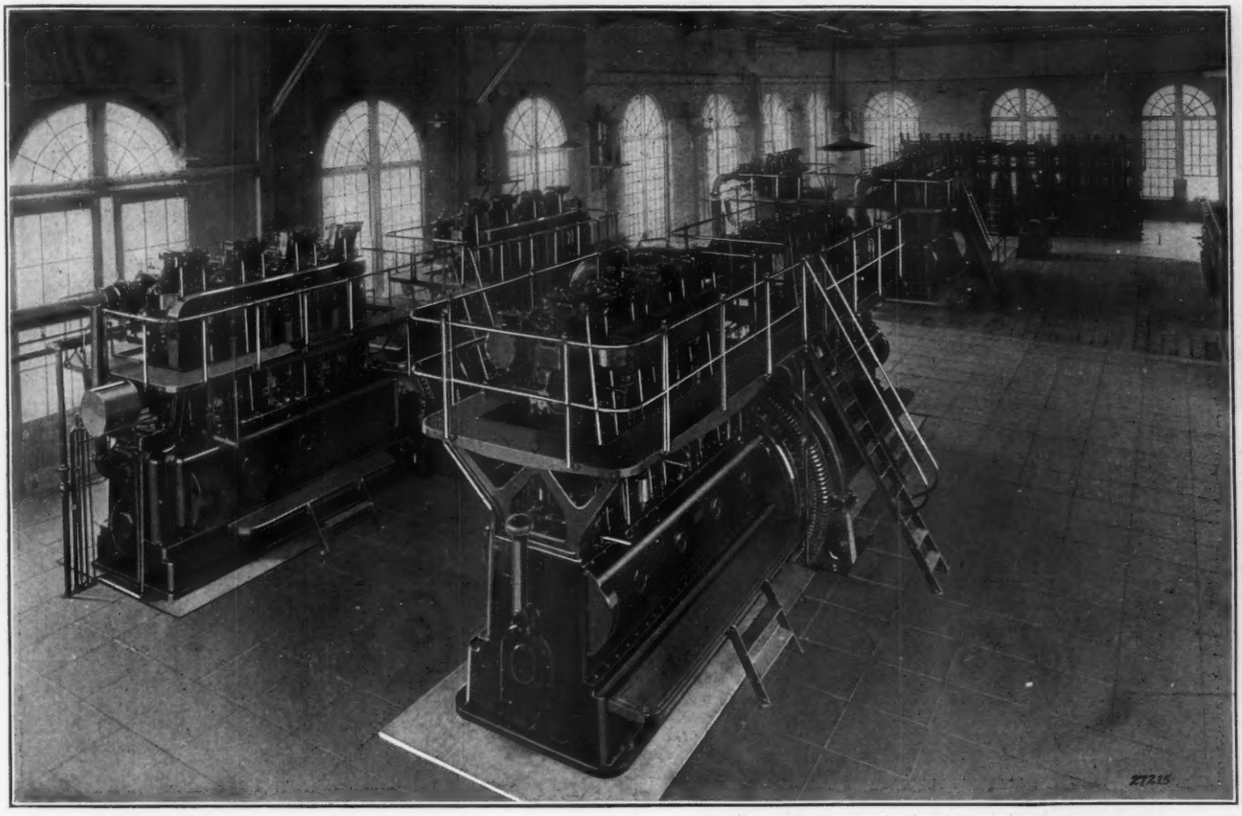

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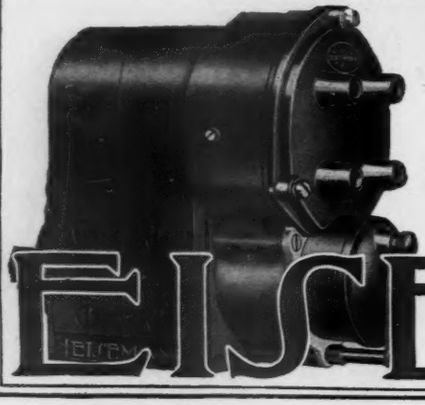

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CONTENTS OF THIS ISSUE

Vol. XXXIII, No. 2, February, 1928

NOTE—For subscription terms see first editorial page

Articles

Sixty Thousand Horsepower From the Connecticut River. *R. G. Skerrett* 2305
Commercial Briquetting of Canadian Lignite 2310
Natural Ventilation 2310
Pneumatic Scrapers Save Time and Labor 2310
When Ships Carried Ice of Nature's Making to Distant Countries. *C. H. Vivian* 2311
A Pullman Power 2312
Pneumatic Vibrator Assures Better Reinforced Concrete. *A. S. Douglass* 2313
Guayule Rubber Promising 2313
Abuse of Air Tools. *J. D. Claghorn* 2314
New York Power Show 2317
Ammonia-Compressor Plant Cools Air in Hospital 2317
Road Show of 1928 2318
Paper Mill in Punjab 2318
Some Diesel-Engined Tugboats in Use on the Pacific Coast. *C. A. Berst* 2319
Restoring Tracks of Oregon Short Line Railroad .. 2323
Special Cabinet Used for Hygroscopic Tests 2324
Underground Cable for Higher Voltage 2324
Operating Steam Hammers With Compressed Air. *H. O. Tair* 2325
Rapid Riveting of Parts in Repair Work 2325
Compressed Air Does Record Work in Utah-Silver-Lead District. *Gail Martin* 2326
Water Power Development in New Zealand 2329
Sphagnum Moss Effective Insulating Material 2329
Division on Air Machinery Proposed for Society ... 2330
Editorial—English Channel Tunnel Project Revived—Panama Canal Paying Handsomely—Greenland's Ice Cap Plays Dual Role—Comforting Statistics 2332
Book Reviews 2332
Handbook on Gas Lift in Blowing Oil Wells 2332

Advertisements

Bucyrus Erie Company 20
Cameron, A. S., Steam Pump Works 21
Continental Motors Corp. 18
Direct Separator Co. 26
Easton Car and Construction Co. 16
Eiseman Magneto Corporation 26
Garlock Packing Co., The 29
Goodrich, B. F. 15
Goodyear Tire & Rubber Co. 7
Harnischfeger Corporation 3
Hercules Powder Co. 11
Ingersoll-Rand Co. 8-9-17-31
International Combustion Engineering 12-13
Jarecki Mfg. Co. 27
Jenkins Bros. 28
Jewett 29
Ladew Co., Inc., Edw. R. 29
Maxim Silencer Co. 30
New Jersey Meter Co. 28
Nordberg Mfg. Co. 30
Oxweld Acetylene Co. 6
Reed Air Filter Co. 23
Smith-Monroe Co. 27
Staynew Filter Corporation 19
Stearns-Roger Mfg. Co. 30
Stowe, George M., Jr. 27
Swartwout Company 28
Union Carbide Sales Company 22
Union Carbide and Carbon Corp. 4-5
Victaulic Company of America 14
Vacuum Oil Co. ..... Back Cover
Waukesha Motor Co. 2
Western Wheeled Scraper Co. 10

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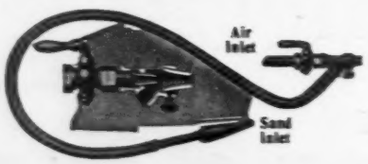

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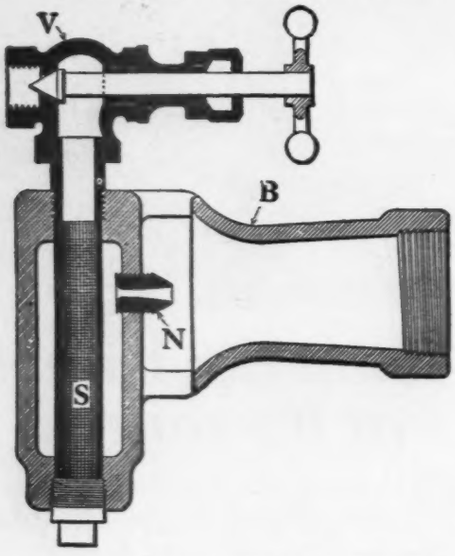

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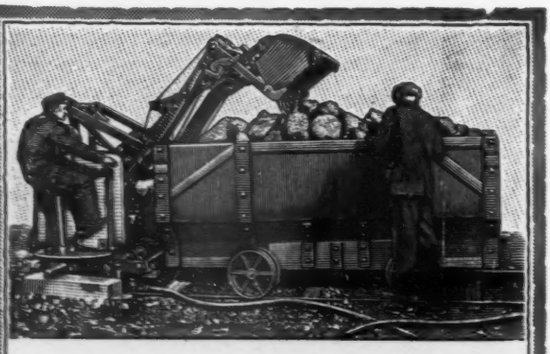

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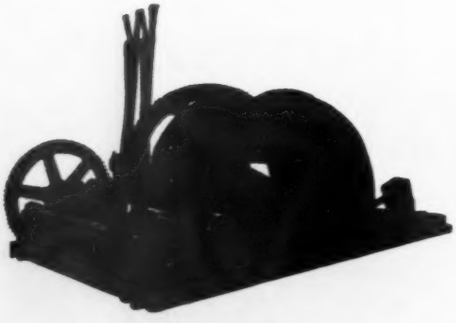

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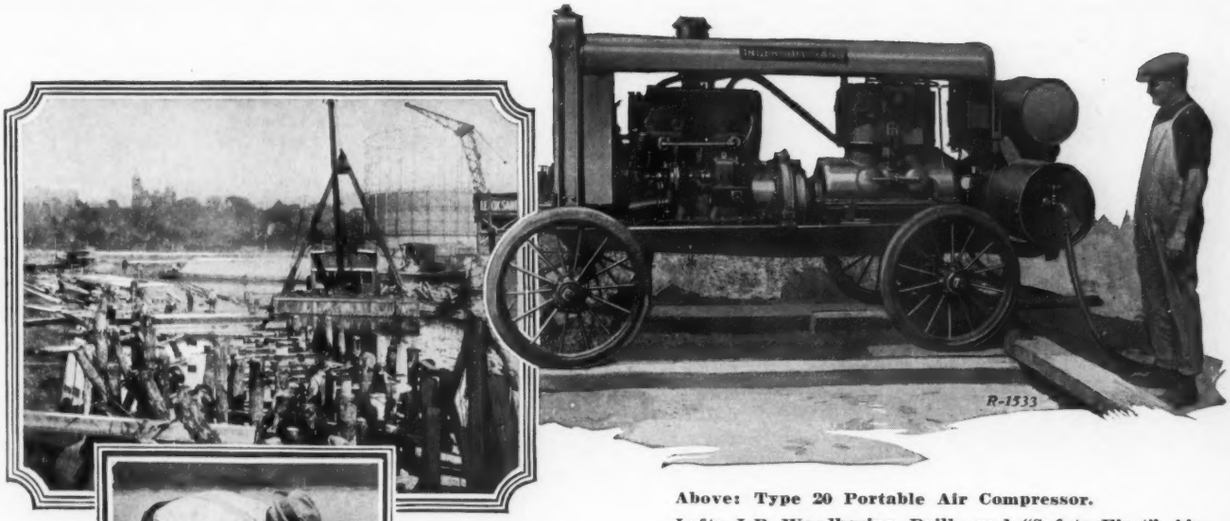

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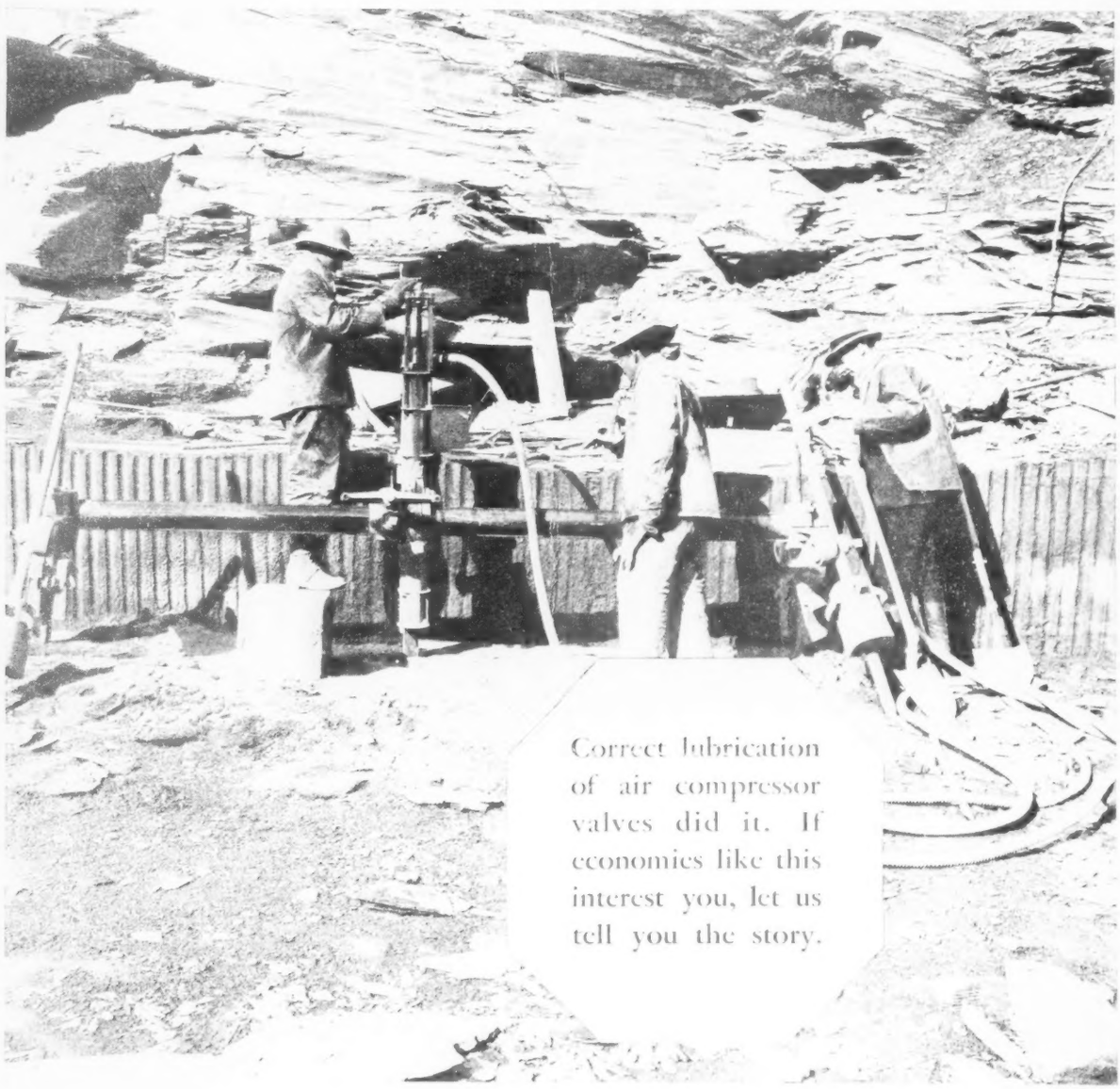

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